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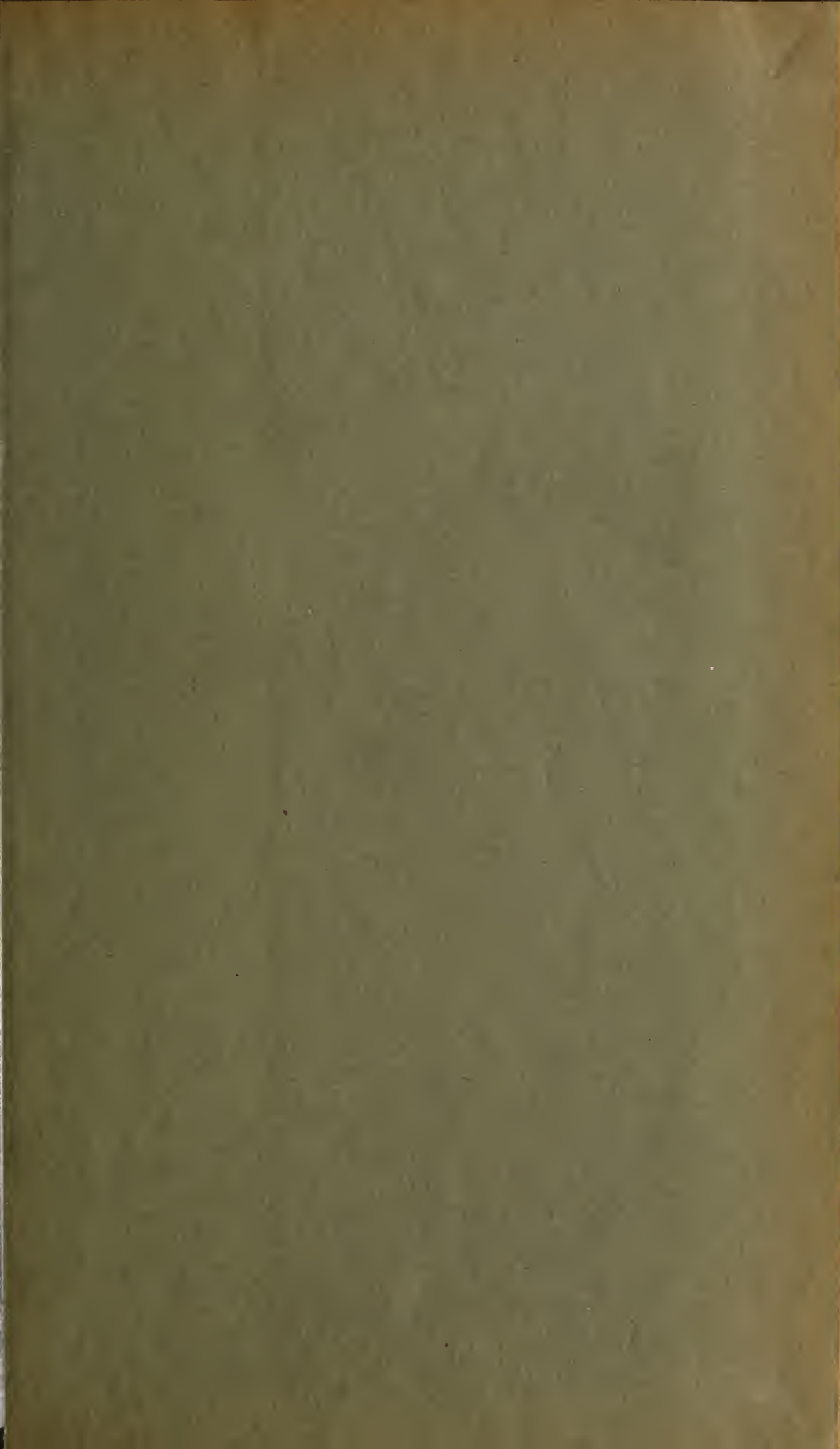
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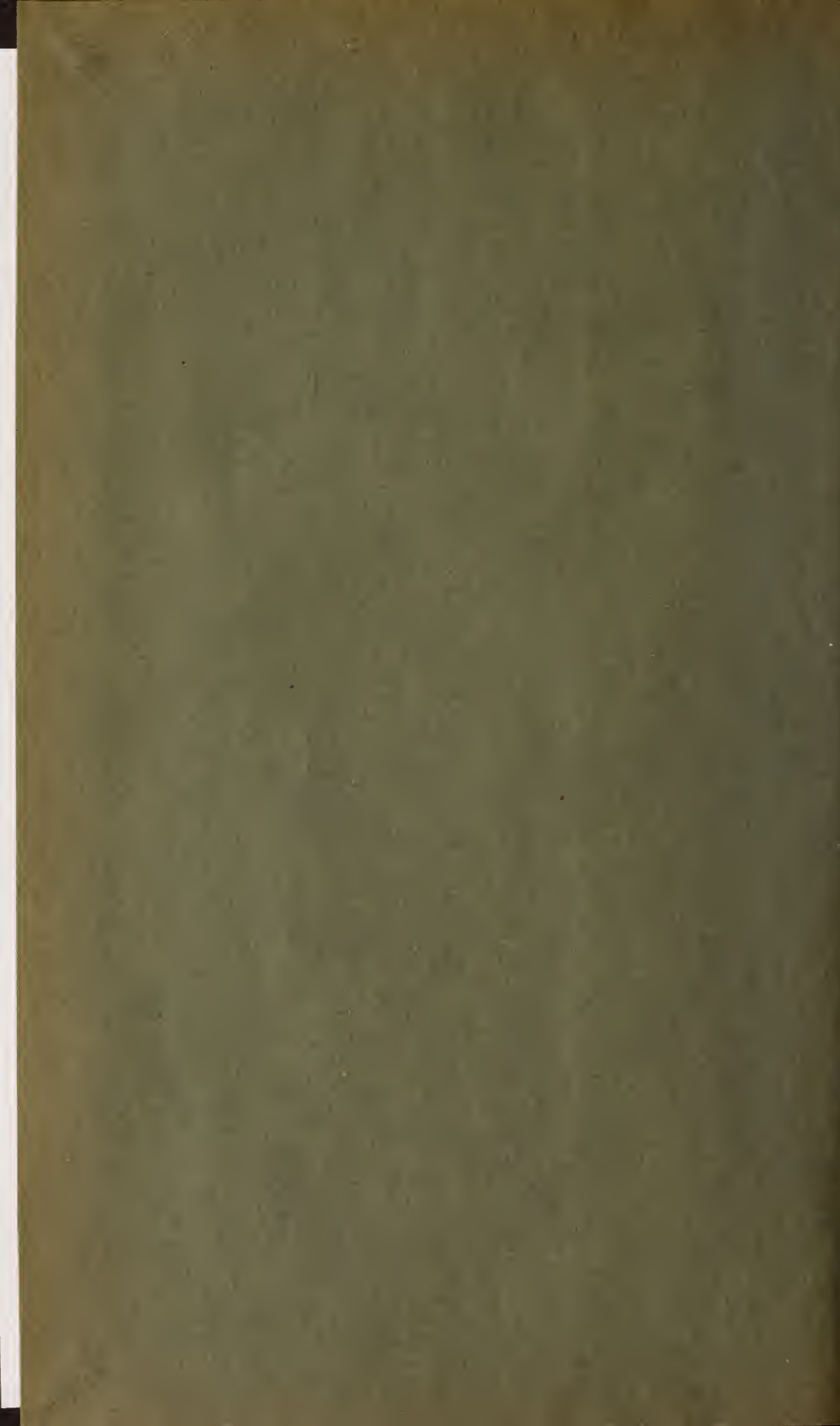
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BRITISH KINEMATOGRAPHY

The Journal of the British Kinematograph Society

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THE LAW OF COPYRIGHT AND THE FILM

Arthur Krestin, LL.B.*

Read to the British Kinematograph Society on October 8th, 1947

A KINEMATOGRAPH sound film consists of a series of photographs which, when projected upon a screen in rapid succession, give the illusion of motion. The film usually incorporates a sound track which produces dialogue or music synchronised to the motion.

Although this Society is primarily interested in the law of copyright so far only as it affects kinematograph films and photographs, the subject cannot be confined to narrow limits for, as will be seen later, a kinematograph film may involve all the subject matters of copyright, namely—literary works, dramatic works, musical works and artistic works, and so, in order to understand the subject of this paper, it is necessary to consider it in broad detail.

Scope of Copyright

By the Copyright Act, 1911, "copyright" means the sole right to produce or reproduce in any material form whatsoever an original literary, dramatic, musical and artistic work or any substantial part of such work, to perform, or in the case of a lecture to deliver, the work or any substantial part thereof in public, and if the work is unpublished to publish it or any substantial part of the work. It includes the sole right to produce and publish translations; in the case of a dramatic work, to convert it into a novel or other non-dramatic work; in the case of a novel or other non-dramatic work, or of an artistic work, to convert it into a dramatic work, by way of performance in public or otherwise; and in the case of a literary, dramatic, or musical work, to make any record, perforated roll, kinematograph film, or other contrivance by means of which the work may be mechanically performed or delivered. It also includes the right to authorise any such acts. In the case of dramatic and musical works, copyright protects not only the written work itself, but also the performing rights.

Works entitled to Copyright

The definition refers to every original literary, dramatic, musical and artistic work, and we must see what is meant by the word *original*. Ideas or opinions are not the subject matter of copyright, but only the form in which the ideas or opinions are expressed, so that the originality referred to is the execution or form of the work. It is not necessary that the work

* Cinematograph Exhibitors' Association of Great Britain and Ireland

should be the expression of an original or inventive thought, for copyright is not concerned with originality of ideas, but with the expression of ideas or thoughts, so that a report of a speech, a photograph of a picture, and a translation of a foreign work are protected.

There is no monopoly in the subject matter of a work. Anybody may produce the same result, provided he does so independently, but to entitle a work to copyright, there must be skill or labour employed in producing the particular form in which the work is expressed, and if there is no such skill or labour employed there will be no copyright, even though the work may embody an original idea or opinion. There is, therefore, no copyright in news as such, but only in the form in which it is expressed, and it is not an infringement of copyright to make a film of actual events, such as a football match or a horse race, and it is thought that there can be no copyright in a photograph of an existing photograph. But if a person takes a photograph of a scene of nature which is identical to a photograph previously taken of the same scene, he will, nevertheless, have copyright in his photograph even though he got the idea of taking the photograph from seeing the previous one.

There is no copyright in an advertisement slogan (although it may be possible to register such a slogan as a Trade Mark), nor is there copyright in the name of a horse selected as a probable winner. It has been held² that a play could not be the subject of copyright because it contained nothing original, it being founded on nothing more than the stock elements of melodrama, but an old subject or common idea, if given a new or original treatment, will be protected.

The skill and labour necessary may consist in the compilation of dictionaries and directories and maps, and even in the mere preparation of lists, provided such lists convey useful information. There may be copyright in notes to a non-copyright text if knowledge, skill and taste are employed in their preparation, and a selection of non-copyright poems which can only be made as a result of a careful reading, study and comparison and the exercise of taste and judgment, is entitled to copyright. Similarly, an arrangement of old music may be entitled to copyright. The name or title of a book, play or film is not generally the subject matter of copyright, unless it is of such length as to constitute a literary composition; it is, however, wrongful to misrepresent to the public the authorship of a work by using a title similar to one identified with another work. Such wrongful use may give the right to damages for "passing off," and it has been held³ that the owner of a copyright work is entitled to prevent any person from "passing off" as a film version of that work, something which is not in fact a film version of it.

Works protected by Copyright

Literary work covers work which is expressed in print or writing, irrespective of whether the quality or style is high, and the words are used in the sense of written or printed matter, but, of course, a mere collection of words, which is not a compilation and the collection of which has not involved any literary skill, is not entitled to copyright.

Copyright in dramatic works subsists, not only in the actual words, but also in the dramatic incidents created, so that there may be an infringement even though no words are actually copied. There can be no copyright in a mere scenic effect or stage situation or gag, which is not reduced into some permanent form, but a piece for recitation, choreographic work, or entertainment in dumb show, the scenic arrangement of which is fixed in writing or otherwise, is protected. A cinematograph film is protected as a dramatic

work, because the definition of dramatic work includes "any cinematograph production where the arrangement or acting form, or the combination of incidents represented give the work an original character." It appears to follow that a film of events in real life is not a "production" within the meaning of this definition, because there is no acting form or arrangement. It has been held that a cinematograph film which does not satisfy the conditions of the definition of a "dramatic work" may be protected as an "artistic work."¹

There is copyright in a musical work, whether it is an original composition or consists in an arrangement of old music, or an adaptation of an existing melody for different instruments. There is also copyright in records, perforated rolls, and other contrivances by means of which sounds may be mechanically produced.

Artistic works include works of painting, drawing, sculpture and artistic craftsmanship. Copyright also subsists in the artistic character or design of any building or structure, or any model of any building or structure having an artistic character or design, but not in any process or method of construction.* A work may be protected as an artistic work irrespective of its artistic merits, but it will not be protected if it is sought to protect an invention or idea, and not the design portrayed. Copyright also subsists in etchings, lithographs, woodcuts, prints and engravings. Also in photographs, photo-lithographs, and any work produced by any process analagous to photography. And as already mentioned, a cinematograph film is capable of protection as an artistic work as well as a dramatic work.¹

Now, having dealt with the kind of works capable of protection by copyright, it must be pointed out that certain works will not be protected. Copyright cannot exist in a work of a grossly immoral tendency², nor in a work which is libellous, blasphemous, or seditious. These works fail to secure protection, because they are contrary to public policy. Elinor Glyn, authoress of "Three Weeks," sued Western Feature Film Co., for infringing her copyright by producing a film entitled "Pimple's Three Weeks"—a film dealing mainly with the adventures of a comedian dressed up as a woman and which was in all material respects different from the novel. The judge refused to grant Miss Glyn any relief whatsoever, upon the ground that the novel was of such a grossly immoral tendency, that there could be no copyright in such a work. The judge further held that the film was of such an indecent character that the Court could not have granted the plaintiff an account of the profits in so immoral a work even if she were entitled to relief.

Published and unpublished Works

Provided a work does not offend against public policy, copyright subsists in Great Britain, Northern Ireland or H.M. Possessions (excluding the self-governing Dominions) in every original literary, dramatic, musical and artistic works, if—

(a) In the case of a published work, the work was first published within the area to which the Act extends, so that this protection applies to works of British or foreign authors; and

(b) In the case of an unpublished work, if the author was at the date of the making of the work a British subject no matter where resident; and

(c) In the case of an unpublished work by a foreigner if resident within the area aforesaid.

A work is published if copies of the work are issued to the public; but the performance in public of a dramatic or musical work, the delivery in public of a lecture, the exhibition in public of an artistic work and the issue of

photographs or engravings of works of sculpture and architectural works do not constitute publication of such respective works. A work is deemed to be first published in a part of His Majesty's Dominions, notwithstanding previous publication in some other place, provided that the time between the publication in such other place and the publication in His Majesty's Dominions does not exceed 14 days, unless the publication relied on as a first publication in His Majesty's Dominions is colourable only, and not intended to satisfy the reasonable requirement of the public.

A foreign author not residing in an area to which the protection of the Act has been extended by reciprocal legislation, does not acquire copyright within that area for his unpublished works; and if first publication has taken place elsewhere, he can never obtain protection in that area. As works are not "published" by public performance within the area, a difficulty has arisen in regard to kinematograph films which cannot conveniently be published by the issue of copies to the public. To overcome this, American film producers have been adopting the device of publishing in this country a short resumé of the chief incidents of the story, and by obtaining copyright for this resumé in effect prevent infringements of their production. It seems, however, that this course is not necessary, because unpublished works of U.S. citizens are copyright in H.M. Dominions under the provisions of an Order in Council of 1915.

Since the Copyright Act, 1911, copyright attaches automatically in countries in which the Act applies, without registration. Before the Copyright Act, 1911, there existed a system of registration, which was particularly awkward in the case of kinematograph films, in that it necessitated the deposit of two complete films at Stationer's Hall. Early producers adopted various devices to avoid this difficulty. Mr. Cecil Hepworth (who was producing films as early as 1896) included in his most important scenes a shop front or other conspicuous object inscribed with a word which had been registered as a Trade Mark—"Hepwix." Other early producers, such as Vitagraph, Lubin and Warwick Trading Company, adopted a similar device—some conspicuous object appearing in the most important scenes. Other early producers would acquire copyright in a film by depositing two sets of "stills" taken from the most important scenes, and so in effect acquire copyright in the film. These devices are, of course, now not necessary.

Ownership of Copyright

Subject to certain exceptions, the author of a work is the first owner of the copyright therein. In the case of a photograph, the person who was the owner of the original negative at the time when such negative was made, is deemed the author of the work, and in the case of records, perforated rolls and other contrivances by means of which sound may be mechanically produced, the owner of the original plate at the time when such plate was made is deemed the author of such contrivances.

In the case of a kinematograph film, the Scottish Courts have held^a that there may be separate authors of the plot, of the scenario, of the arrangement of the scenes to be filmed, and of the artistic work comprised in the film itself. The person who arranges the scenes to be filmed seems to be the owner of the copyright in the production. The person who owns the negative is the author of the artistic work in a film, and in the case of a non-dramatic work, *e.g.*, a film of events in real life, the owner of the negative is the only owner of the copyright. In practice, this position of having different owners of copyright in a film does not often arise, because the scenario writers and directors are usually employed under a special agreement by which their work becomes the property of their employers.

There are cases, however, in which the author is not the first owner of the copyright, and one of these is where certain works are executed on commission. If the plate or other original of an engraving, photograph or portrait is ordered and made for valuable consideration, in pursuance of the order, then, in the absence of agreement to the contrary, the person giving the order, and not the author of the work, is the first owner of the copyright therein. But if a person who asks for a photograph to be taken belongs to the class of person whom photographers are accustomed to photograph without payment, *e.g.*, actresses, then there may be no implied promise to pay, and the copyright would belong to the photographer. If, on the other hand, a person is photographed at the invitation of the photographer, the copyright belongs to the photographer, even though the sitter pays for some copies, and the sitter cannot restrain publication of the photograph unless the publication is defamatory.

Further, the copyright in a snapshot will belong to the owner of the negative, for the reason that it has not been ordered for valuable consideration, and the person who has been snapshotted cannot object to publication of the snapshot. Another case in which the author is not the first owner of the copyright is where the author of the work is in the employment of another, under a contract of service or apprenticeship, and the work is made in the course of his employment by that other person, then the employer is, in the absence of any agreement to the contrary, the first owner of the copyright.

Term of Copyright

The term of copyright in photographs, photo-lithographs and any works produced by any process analagous to photography, is 50 years from the making of the original negative, and it does not make any difference whether the photograph be published or unpublished. The term of copyright in records, perforated rolls and other contrivances by means of which sounds may be mechanically produced, is 50 years from the making of the original plate from which the contrivance was derived. In the case of literary, dramatic, musical or artistic works, the period is the lifetime of the author, composer or artist, and 50 years after his death. In the case of literary, dramatic or musical works and engravings which have not been performed or published, or in the case of a lecture, delivered in the lifetime of the author, the period is up to and 50 years after the first publication, performance or delivery in public. This does not apply to photographs, because copyright in them runs from the making of the negative whether published or not. Nor does it apply to artistic works (other than engravings) because copyright in them comes to an end 50 years after the artist's death, whether published or not. In the case of joint authors or composers, the term is the lifetime of the first to die and 50 years after his death, or the lifetime of the author or composer who dies last, whichever is the longer.

The Royalty system of Reproduction

Twenty-five years after the death of the author of a published work (or thirty years where copyright existed before 1911) anybody is entitled to reproduce the work for sale, provided he gives notice in writing of his intention so to do, and pays to the owner of the copyright 10% royalty on the price at which he publishes the work. This applies only to published works, meaning where copies have been issued to the public, so it does not apply to musical or dramatical works which have only been performed in public, but which have not been published by the issue of copies to the public. This provision does not give any right to perform in public a musical or dramatic work which has previously been published or performed, because that would

not be a "reproduction of the work for sale," so nobody can "muscle in" on performing rights during the whole period of protection, and the provision does not appear to apply to photographs and mechanical contrivances, and in my view cinematograph films cannot be reproduced for sale compulsorily on a royalty basis under this provision. A person adopting this course of compulsorily reproducing a work for sale on a royalty basis is not entitled to produce the work in a different form, as for example, by converting a novel into a film play.

Recording

Once a musical work has been mechanically recorded, or a contrivance made by means of which the work may be mechanically performed with the consent or acquiescence of the owner of the copyright, anybody is entitled to make further records or contrivances upon giving notice to the owner of the copyright and paying to him royalties at the rate of $6\frac{1}{2}\%$ upon the ordinary retail selling price of the record or contrivance. It must be specially noted that this provision in the Act only applies to "musical works," but for the purpose of this provision, a musical work includes any words so closely associated therewith as to form part of the same work. Clearly, a cinematograph sound film is a contrivance by means of which works may be mechanically performed, and an important question that may arise, is, whether this provision would enable a sound film to be made of works which have been previously recorded on gramophone records. Formerly this question was not of importance, because sound films were not put on the market for public use and so the royalty system (which is based upon the selling price) was not applicable. But the question may become of importance with the marketing of sound films for use of the public, and it would appear that a person complying with the conditions before mentioned, *i.e.*, the giving of notice and the payment of royalties, would be entitled to make a sound film from works which have previously been recorded on gramophone records with the consent of the owner of the copyright. And similarly, it would appear that anyone complying with the said conditions would be entitled to make gramophone records from works which have previously been reproduced by means of sound films. The person exercising this statutory licence is not entitled to make alterations in or omissions from the work reproduced unless contrivances reproducing the work subject to similar alterations and omissions have been previously made by or with the consent or acquiescence of the owner of the copyright, or unless such alterations are reasonably necessary for the adaptation of the work to the contrivance in question. It must be pointed out that this provision does not enable a person to make gramophone records or other mechanical contrivances directly or indirectly from previously made records or other mechanical contrivances. The second manufacturer must make his record independently, and not copy the first record. A record or other mechanical contrivance by means of which sounds may be reproduced, is itself accorded copyright under the Act, but this copyright is subject to the rights of the owner of the work which has been recorded except so far as such owner's rights are affected by the Act. The result appears to be, that a person who has manufactured records or other mechanical contrivances on the royalty system, has an implied right to authorise the use of such records or contrivances by performance, but such performance must be private, otherwise there will be an infringement, both of the performing rights in the original work and of the performing rights in the record.

Assignment of Copyright

A person who purchases a book or a portrait (other than one made to his

order) does not acquire the copyright in it, so he cannot reproduce it by making copies of the book, or by making photographs of the portrait unless he has obtained a licence or an assignment of the copyright. Copyright may be assigned either wholly or partially, and either generally or subject to limitations as to any place to which the Copyright Act, 1911, extends, and either for the whole term of the copyright or any part thereof, and the owner of copyright may grant any interest in the right by licence, but no such assignment or grant shall be valid unless it is in writing signed by the owner of the right or by his duly authorised agent. Provided that where the author of a work is the first owner of the copyright therein, no assignment of the copyright, and no grant of any interest therein, made by him (otherwise than by Will) shall operate to vest in the assignee or grantee any right with respect to the copyright in the work beyond the expiration of 25 years from the death of the author, and any reversionary interest after the termination of that period shall on the death of the author, notwithstanding any agreement to the contrary, devolve on the author's personal representatives as part of his estate. This proviso would hardly affect the right to grant assignments or licences of copyright in cinematograph films because the author would not be the first owner of the copyright.

Entitlement to owners of Copyright

The result is, that the owner of copyright may retain part of his rights, and may assign other parts. So he can assign the stage rights to one person and the film rights to another. And he may grant a licence to make a film of the work, either exclusively or not, and an assignment or licence may be limited in territorial operation. So that there may be assignments or licences granting exclusive performing rights in plays to one person say in London, and to some other person in the provinces. If it is desired to acquire the sole rights throughout the world, to make a film play from a particular work, this must be expressly mentioned in the agreement, otherwise it may be found that other persons have similar rights, or exclusive rights in particular areas, and it has been held⁸ that where a licence was given to produce a work "in moving pictures" this did not authorise the production of a sound film of the work, though the learned Judge in that case said, that "cinematograph films" would include sound films and "cinematograph rights" would include the right to make sound films. On the other hand, if it is intended to limit the rights to be assigned, this also should be clearly stated, and it was held⁹ that where an assignment gave the assignee the exclusive right of production in Great Britain and her colonies of the next three plays to be written by a certain famous French dramatist (M. Sardou), the assignment included the cinematograph rights also. And in another case¹⁰, an assignment of "entire rights for the United Kingdom, the United States of America and the Dominion of Canada" in the play "The Scarlet Pimpernel," was held to include the cinematograph rights.

Infringement of Copyright

A very important aspect of the subject to this Society is the question of infringement of copyright. It has already been explained that copyright is the sole right to do certain things and the sole right to authorise others to do such things. Copyright is infringed by any person who without the consent of the owner of the copyright, does anything, the sole right of which is vested in the owner. But there is no monopoly in the subject matter of a work, and if it can be shown as a matter of fact, that two similar works were produced quite independently, then the author of the first work cannot

restrain publication by the author of the other work, and for the same reason, there is nothing to prevent a person taking a photograph of an object which has already been photographed.

If the owner of the copyright gives consent to an act which would otherwise be an invasion of his right, then there is no infringement. Consent, to prevent an infringement, must where there are several owners, be the consent of all of them, so that it is an infringement for one co-owner to reproduce or perform a joint work without the consent of his co-owners.

Infringement by Reproduction

It is an infringement of the Copyright in a copyright work to reproduce the work, or any substantial part thereof, in any material form whatsoever, without the consent of the owner of the copyright. It is an infringement even to make one infringing copy. It is also an infringement not only to make exact copies, but also to make colourable imitations. But if a work is only an imitation of the plaintiff's idea as distinct from the form or expression of the idea, or if the resemblance is due to coincidence or derivation from a common source, then there is no infringement. The onus of establishing breach of copyright is on the plaintiff to show that the defendant in making his work has appropriated the labours of the plaintiff. Whether or not the plaintiff's labours have been appropriated, is one of fact which may be inferred from evidence, that there are errors common to both works. Further, to constitute an infringement, a substantial part of the work must have been copied, and here again this is a question of fact.

It has been held¹¹ that where a sound film recorded 20 bars of a military march, such recording amounted to a substantial part of the work. And in another case, it was said that, even 8 bars might constitute a substantial part of a musical work. In deciding this point, one has to examine the value of the part copied as well as the quantity.

It is an infringement not only to reproduce the work in the same form, but to reproduce it in another way, so for example, a photograph may infringe the copyright in an engraving, and an arrangement of stage scenery may infringe the copyright in a picture. It is, of course, also an infringement of copyright to produce or publish a translation of a work, to dramatise a novel, to make a novel of a play, and to make a record, cinematograph film or other contrivance whereby any literary, dramatic or musical work may be mechanically performed or delivered. In considering whether a play constitutes an infringement of copyright in a novel or in another play, it does not follow from the fact that words have not been copied, that there is no breach of copyright, and if a plaintiff can show that the combination or series of dramatic events in the infringing play have been taken from the like situations in the plaintiff's works, then he will have established a breach of copyright. It is, however, not an infringement of copyright to make use of another person's plot, but it is an infringement to reproduce the dramatic situations in substantially the same sequence and arrangement of some other copyright work. The Court will have regard to the dramatic value from another work.

Infringement in Films

In considering whether a cinematograph film is an infringement of copyright in a novel, one must ascertain whether there is such a similarity as to lead one to say that the film is a reproduction of the incidents described in the novel or of a substantial part thereof. If a film uses in its sound dialogue a substantial part of the words of a novel or play or colourable imitations thereof, or uses in its pictures a substantial part of the dramatic incidents

represented, or colourable imitations thereof, then there will be an infringement. It seems to follow, therefore, that the copying of single pictures from a film cannot be restrained by the owner of the dramatic copyright in a film, but it probably could be restrained by the owner of the artistic copyright in the film. It is not an infringement of copyright to make a film or photograph, either of works of sculpture or artistic craftsmanship permanently situate in public places, but this exemption does not apply to films or photographs of paintings and drawings.

The second way in which copyright is infringed, is by performance in public. Performance means any acoustic representation or any visual representation of any dramatic action in a work, including a representation made by means of any mechanical instrument. Broadcasting a work is a public performance of the work, and it was decided¹² that a person who switches on a receiving set in public is responsible for a public performance, and will infringe the author's copyright, even though the performance at the broadcasting studio is authorised. Exhibition of a cinematograph film amounts to a performance of the dramatic work, which it represents, and also of the artistic work constituted by the pictures making up the film. As to what is a performance in public, is a question of fact. A performance which is of a private domestic or quasi-domestic character will not constitute an infringement of copyright, even if given without the consent of the owner of the performing rights. A performance may be held to be a public one even though not given for profit. A test usually applied is whether the performance in question is likely to injure the author's right to earn money from his work.

Publication without Consent

Copyright is infringed by publication, without the consent of the owner of the copyright, of any unpublished work or any substantial part thereof.

It is an infringement of copyright to deal with, *i.e.*, sell, hire, offer for sale, etc., an infringing work. These provisions are important in that they prevent persons making profit out of infringement of copyright committed by other persons.

Liability for Infringement

It is an infringement of copyright to authorise any act, which if done, would constitute an infringement, and a person is liable for any infringement if committed by his servant in the course of the servant's authority. And it is also an infringement actively to direct or aid another to commit an infringement. In the case where the proprietor of a music hall engaged an artiste, and authorised him to sing what songs he liked, the proprietor was held liable for infringement, because he failed to exercise proper supervision or control so as to prevent the artiste singing copyright songs. It is also an infringement to grant or purport to grant a right to do an act, which if done, would constitute an infringement, so it is an infringement to let the right of performing a cinematograph film, if the performance of the film would constitute an infringement.

Where a person for his private profit permits a theatre or other place of entertainment to be used for the performance in public of any work without the consent of the owner of the copyright, he is liable for infringement, unless he was not aware and had no reasonable ground for suspecting that the performance would be an infringement of copyright.

Copyright in any literary, dramatic or musical work is infringed by making, without the consent of the owner, any record, cinematograph film, or other

contrivance by means of which the work may be mechanically performed. But, as will be remembered, it is not an infringement if certain conditions as to giving notice and payment of royalties are complied with.

Also copyright is infringed where the owner of a copyright in a work has given authority or granted a licence to another person to deal with or exercise any of the rights comprised in copyright work, and where such authority or licence is exceeded. And so in one case¹³ where the Plaintiff granted a licence permitting one of the Defendant's concert parties to perform the Plaintiff's song, it was held that the Defendant was guilty of infringement by secretly allowing others of his concert parties to perform the same song without the consent of the Plaintiff. And in another case¹⁴, a person who had been granted the right to exhibit certain films in certain specified kinemas, was held to have infringed the copyright in such films by exhibiting them in other kinemas. It is also an infringement of copyright to treat the work in an unauthorised manner, and so in one case¹⁵, the Plaintiff was granted an injunction to restrain the Defendant from introducing a song not written by the Plaintiff into the latter's plays. If the film rights in a play are granted, it is permissible for those producing the film to make any reasonable alterations or deviations from the original play which may be necessary for adapting a play with dialogue to the requirements of the film, but any substantial departure from the original play and the sequence of its incidents will amount to an infringement, which will be restrained by injunction¹⁶.

Acts which do not constitute an Infringement

It remains to be added in connection with infringement of copyright that in certain cases of appropriation of part of another person's work, such appropriation will not amount to an infringement—this is where the appropriation in question amounts to no more than a fair dealing with any work for the purposes of private study, research, criticism, review or newspaper summary. The words "newspaper summary" are confined to their literal meaning, and it was held¹ that the reproduction in a news film of a current event involving the playing of music by a band did not obtain the protection applicable to newspaper summary. It is not an infringement in a work of sculpture or artistic craftsmanship permanently situate in a public place or building, to make or publish drawings, paintings or photographs of such works, and it is not an infringement of copyright in an architectural work of art to make or publish drawings, paintings or photographs of such works.

A person to whom copyright in a work has been assigned, is entitled to publish the work in any way he pleases, and it will not be an infringement of copyright that the publication may be in a form which may injure the author's reputation, and the author has no remedy unless the work is published in such a manner as to hold him up to hatred, contempt or ridicule, so as to amount to a libel. So that where a cinematograph film is ordered and made for valuable consideration in pursuance of the order, the copyright in the film belongs to the person giving the order, and it would appear that the person for whom the film was made is entitled to make alterations in the film, and the maker of the film cannot prevent such alterations from being made unless they are of such a nature as to hold the maker of the film up to hatred, contempt or ridicule. The mere fact that the film is published in a form likely to injure the maker's reputation, if falling short of a libel on the author, will not give the author any remedy.

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DISCUSSION

Mr. G. MORGAN: In connection with Orders in Council, is there any duration fixed? If an Order in Council has extended reciprocal protection to another country, does it refer to an individual work or to all works during the period? If the Copyright Union referred to as the Berne Convention of 1911, of which a number of nations were signatories and the United States was not? Did the signing of that convention confer any International rights of copyright?

THE AUTHOR: The Berne Convention of 1887 constituted the signatories thereto into what is known as the "copyright union." This was followed by the Additional Act of Paris in 1896 and the Revised Berne Convention in 1908. The Copyright Act 1911 gives to British works rights as large as those required by the Convention, and by Orders in Council extends those rights to works originating in foreign countries. The Orders in Council operate from the date of the Order or such other date as the Order may provide and continue until revoked. They usually specify the works in respect of which they give protection.

Mr. B. HONRI: A film might be made and reference made to certain photographs for getting accuracy of detail. Would the publication of the film be an infringement of the original photograph?

THE AUTHOR: No, not unless the photographs or a substantial part of them are copied in the film.

Mr. B. HONRI: Would there be an infringement if an author were photographed outside his house and the photograph was later used to secure accuracy in a subsequent film?

THE AUTHOR: The copyright in the snapshot would belong to the owner of the negative when the snapshot was taken, and he would be entitled to publish it as he pleased provided that its publication did not constitute a libel on the person photographed. But if the snapshot or part of it were reproduced by another person without the consent of the owner of the copyright, that would constitute a breach of the artistic copyright in the photograph.

Mr. T. S. LYNDON-HAYNES: Supposing we went along to a country house to shoot a couple of scenes and during the course of the film it was inferred that the house was being used for unlawful purposes, and no fee had been paid for hiring the house, could the owner of the house claim that he had been libelled?

THE AUTHOR: If the owner of the house knew of the purpose for which it was being filmed, and acquiesced in it, then he could not afterwards complain. If he did not know that shots of the house were to be used as the setting for unlawful deeds, then I doubt whether he would be successful in an action for libel unless the house were a very well-known one and the purpose of the film was to hold the owner up to hatred, contempt, or ridicule. The owner of the house might, however, be able to restrain publication on the ground of breach of confidence or trust.

Mr. G. MORGAN: I am a screen writer, and last Saturday in Paris we had a conference. Each of us has a registration bureau in our own countries, for original screen stories. It was suggested then, that there might be some system by which our

three registration bureaux might confer protection in our countries for scripts submitted, provided that copies were filed with each.

Mr. W. WILHELM : I saw recently a film I wrote the original story of. For some reason the film was cut in pieces and did not make sense. Can the writer claim infringement of copyright or defamation of his personal character? Provincial cinemas tend to cut a film to pieces. Is there any chance for the screen writers' organisation to take legal steps?

THE AUTHOR : I cannot imagine that alteration which materialises by the bad condition or breaking of a film, and the joining up of ends, thereby cutting out important parts, could ever amount to libel. It might injure the author's reputation, but it would probably not amount to libel, and he would thus have no remedy.

Mr. W. WILHELM : If you write a story which is sold to an American film Company, and they show at the end of the film that Reuter, when he was attacked in the House of Commons, addressed the House from the Distinguished Strangers' Gallery, is there a chance for an author to take steps against that sort of thing?

THE AUTHOR : I should say not. It is very unfortunate, but that would not appear to amount to a libel on the author.

Mr. L. KNOPP : To what extent can an altered musical work infringe a copyright? I have in mind a dance tune based on "Rock of Ages."

THE AUTHOR : If there were copyright subsisting in the music of "Rock of Ages," then an adaptation of it would constitute breach of copyright, notwithstanding that the words were different. The "jazzing" of copyright works is an infringement of copyright, but writers of dance music could use old tunes in which the copyright has expired.

Mr. N. LEEVERS : Can there exist any copyright in a performance which does not come within the classification of music as we write it, or speech as we write it? To quote a particular case, a performer earns his living by performing copies of bird sounds; he gives a public performance of certain copies of bird sounds which is broadcast. The broadcasting authorities wish to use those sounds for other purposes, and to record them. The performer states that it is infringing the copyright of his material. Was there, in fact, any copyright of such material?

THE AUTHOR : Did he record the sounds himself?

Mr. N. LEEVERS : No; he does not possess any recording instrument.

THE AUTHOR : Unless he gets those sounds into some permanent form he will never have any copyright in them. He could only get copyright by making a record of them and the record would be copyright.

Mr. N. LEEVERS : If he made a recording, say, of the song of the nightingale, he would only have copyright in that performance as long as he made a replica of the original recording at each performance—that each note was the same?

THE AUTHOR : He would have copyright in his record, and he could restrain anybody from reproducing the record or a substantial part of it without his consent. But he would have no copyright in imitating a nightingale, and he could not restrain another person from doing so, even though that other person got the idea from hearing the record.

Mr. R. H. CRICKS : I take it that the remarks you have just made would apply to a television transmission of a news event?

THE AUTHOR : The Act only accords copyright to mechanical contrivances by means of which sounds may be mechanically performed. News is not copyright, but only the form in which it is expressed, and a television representation of a news event would be purely a transitory affair.

Miss ROBINSON : How does the law of copyright apply to a library which provides microfilm copies?

THE AUTHOR : The copyright in a photographic copy of a work is subject to the rights of the owner of the copyright in the work which has been copied.

Miss ROBINSON : I really meant, were they infringing copyright of a work by allowing reproduction?

THE AUTHOR : They certainly were, if they did not have permission. The owner of the copyright in the book in question could ask the Court for an injunction and damages. Where infringing works have been made, the law says that every infringing work is the property of the owner of the copyright, and he can ask you to hand them over.

Mr. R. H. CRICKS : Would the performance of a film or record at B.K.S. meetings, to which only members and visitors are admitted, constitute an infringement?

THE AUTHOR : A performance in private is not an infringement. The whole question depends upon whether the performance of a film in this theatre would injure the owner's right to earn money from the film. If you showed a film here, you would probably not be limiting the film's market, and I think the performance would be regarded as of a domestic or private character.

THE TECHNICAL DESIGN OF THE PROJECTOR

R. Robertson, B.Sc., M.I.Mech.E., M.B.K.S.*

Read to the B.K.S. Theatre Division on January 19, 1947. The paper which followed, on "The Design of the Projection Room," by Major C. H. Bell, O.B.E., M.B.K.S., is being printed in an amplified form in a later issue.

WHEN one analyses the operating conditions which the kinematograph projector must satisfy, one may well be surprised that a projector can be made to function at all satisfactorily, let alone to give ten years or more of good service.

Kinematograph film, a highly inflammable material, easily torn or scratched, subject to shrinkage and warping, must be fed intermittently through the picture gate, being stopped dead 24 times a second; then snatched forward and again stopped dead with the next frame in position; while a few frames ahead—one second in time—it must be running at absolutely constant speed through the sound gate.

The whole of the light necessary to illuminate the screen must pass through each frame in turn as it is stationary in the gate. This represents a concentration of something like one horse-power on an area of celluloid 0.825×0.620 in.

It is not sufficient that the film stop dead momentarily in this inferno of light and heat, but it must be stopped in absolute register and focus, since any error is advertised upon the screen, magnified perhaps by 300 or 400 times.

In addition to the fundamental requirement of a sharp, steady, well-lit picture, and reliable, silent, operation, the projector must conform to certain more or less closely defined standard requirements.

Kinematograph film is probably the most widely accepted standard thing in the world. This is all to the good, but of course, necessarily imposes some limitation on the freedom of the designer. For example, the distance of 24 frames between picture and sound gate does not allow much latitude in the layout of the film path.

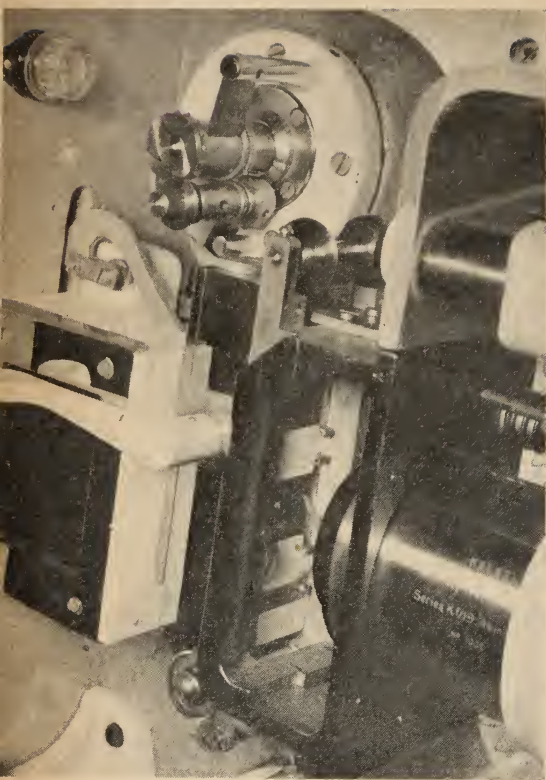
Soundhead, Lamp and Lens

Maintenance of adaptability to any soundhead is a troublesome matter, involving numerous cramping and not very clearly defined restrictions. Since the projector is usually mounted upon and driven by the soundhead, it is not only the drive arrangement which must be watched, but the base plan, holding-down bolts and available driving power—also any gears, flywheels, or the like, projecting above the top face of any soundhead. It is also necessary to maintain correct presentation of the film to the soundhead and correct synchronisation between picture and sound.

Modern American projectors and soundheads are built around a common standard, which does simplify matters, but this appears to have arisen fortuitously, and its strict observance imposes severe and inconvenient restrictions on the design of the projector—in particular, the holding-down arrangement, and the small 17-toothed driving pinion involved are by no means what a designer would choose if given a free hand.

In contrast, the requirements of the lamp designer are quite simple: he wants to get his lamp as close up to the gate as possible; the closer he can get, the more light he can give with an optical system of given diameter. He expects also conformity with generally accepted optical height.

* A. Kershaw & Sons, Ltd.



The massive parallel opening gate of the G.K.21 projector.

to projectors in the infancy of the art by the late Robert Paul.

The accelerations and consequent stress involved during the transport period are quite imposing. The film is moved $\frac{3}{4}$ in. in $1/96$ of a second. It is subjected to an acceleration reaching a maximum rate of about 4,850 ft./sec² or 152 *g*'s, and attains a maximum speed of 865 ft./min.—nearly 10 times its average speed through the projector.

Needless to emphasise, it is desirable to keep the cross and sprocket as light as possible consistent with adequate accuracy and rigidity, in order to reduce to a minimum the inertia forces involved, also the mechanism must be as direct acting as possible—the intermittent sprocket must be mounted directly and as solidly as possible upon the cross shaft, and the flywheel should be mounted directly upon the cam shaft and not geared thereto.

Numerous attempts have been made to supplant or improve the simple 4-station cross, but nothing has been found which so well meets the exacting conditions. Much attention has been given also to develop "continuous projectors" employing some form of optical compensation for the film movement, thus avoiding the necessity for intermittent film movement, but these efforts have been equally fruitless.

Continuous projectors are particularly delusive, since it is not difficult to show a fairly promising picture with a quite simple arrangement, but all the systems proposed involve inherent defects, and the step from "fair" to "good" requires the introduction of intolerable complications.

The lens designer, too, wants to get close up to the gate with a big diameter lens, to collect all the light available.

Finally, differing legal enactments and underwriters' requirements, also differing operating conditions and prejudices throughout the world, must be watched, and some generally acceptable compromise formed.

As an example, a requirement in certain markets, such as the U.S.A. and Canada, is that the operating side and the light beam must be enclosed. In certain other markets there is a definite preference for an open projector. Both types have their advocates, but in practice, it appears that while an operator prefers the type to which he is used, the trend is towards the enclosed machine with its advantages of cleanliness and more silent running resulting from reduction of film noise.

It is within the limitations thus briefly outlined, that the projector designer must fit the "works," and we pass on to consideration of these.

Maltese Cross Mechanism

All modern 35 mm. projectors employ as an intermittent unit the well-known 4-station Maltese cross mechanism, which was first applied

Closely associated with the intermittent mechanism, is the shutter. It is preferable that the flicker obturation should exactly balance the cover obturation. If it is cut down one does certainly gain some light, but at cost of flicker.

Since the film movement takes place during one quarter of the picture cycle, the light should, in theory, be cut off for two periods per picture each of 90 deg., *i.e.*, for half the cycle, corresponding to a light efficiency of 50%. In practice, however, since the shutter has to cut across a light beam of sensible width, transition from full light to complete dark cannot be instantaneous, resulting in an intervening "twilight" period of reduced illumination and a corresponding reduction of efficiency below the theoretical ideal of 50%. In part compensation, however, the "twilight" period can be allowed to encroach to a limited extent into the period at the beginning and end of the film movement, before the film has got into its stride, and again, as it is coming to rest. This encroachment cannot be overdone, however, or film movement will be evident as ghost, but it is practicable to attain or even somewhat exceed the theoretic ideal 50% efficiency.

An obvious design point is to cut the light beam where it is narrow with a relatively large diameter fast moving blade. It is usual to employ a 2-bladed shutter making one revolution per picture, *i.e.*, 1,440 r.p.m. Earlier it was usual to mount the shutter in front of the lens at the narrowest part of the light beam.

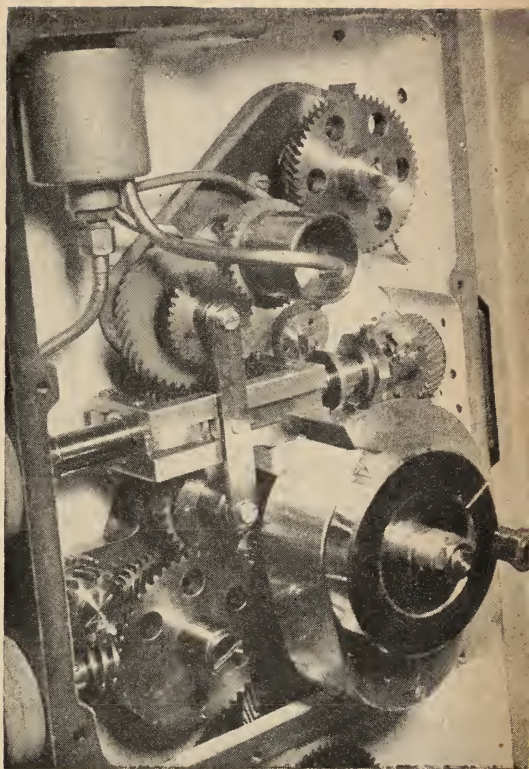
This is an efficient arrangement, but results in the gate and film being continuously exposed to the heat of the arc. In contrast, placing the shutter behind the gate effects a 50% reduction in the heat concentrated on the gate; further, a shutter in this position can be used also as a fan to maintain a cooling flow of air around the gate.

Scissors Type and Twin Shutters

The current trend in 35 mm. practice is towards the use of a scissors type shutter, halving the twilight period by cutting the beam simultaneously from opposite sides.

An obvious scheme employed in several modern projectors is to use a pair of shutters running in opposite directions. This does involve some extra mechanical complication, but passes from 10-20% more light than is possible with a single shutter of equivalent dimensions.

An interesting variant of this arrangement is the use of twin shutters running in the same direction, but on opposite sides of the projector lens, a



The gearing of the G.K.21 projector head. The sliding spiral gears serving for shutter phasing compensation can be seen. The oiling system feeds filtered oil to all components.

front and rear shutter. Since the effect of the lens is to invert the light beam, the two shutters, though running in the same direction, attack the light beam from opposite sides.

The very popular drum shutter is in effect a scissors-type shutter. Provided it is fitted close to the gate, it is surprisingly efficient even in a quite small size, and is difficult to beat at a moderate optical aperture. Its efficiency is not much increased by increase in size, and tends to fall away with increase in angle of the illuminating beam—in effect, it becomes swamped by a wide angle beam—and at apertures above $f/2$ is about the same as that of an ordinary rear shutter of convenient proportions.

Even then, however, it has much to commend it, being very compact and enabling a very simple gear train, without the complications and power losses associated with the right-angled drives required by other shutter types.

It can be fitted with centrifugal flaps to form a very simple automatic safety shutter, and it is more adaptable to the pull-through soundheads favoured in some overseas markets than is the usual rear shutter machine, the shutter casing of which is apt to come in the way.

Reduction of Heat Absorption

Minimisation of heat is a matter of great importance, and some overseas countries insist upon fitment of various special cooling arrangements to keep down gate temperature.

All useful light sources give out also a lot of non-luminous radiation which adds to the heating effect without contributing to the illumination.

We can however “cool” light by using a selective filter to screen out some of the non-luminous radiation. Suitable glass is now available, but it does involve some loss of light, and the problem arises of getting rid of the heat absorbed. In France, the use in the light beam of a glass cell containing an absorbing solution has been compulsory for many years, but the attendant light loss appears to be greater than with the new glasses.

Unfortunately, however, the heat problem is most acute in extreme conditions, where the difficulty is to get enough light for the screen anyway, and the loss involved by the use of a filter cannot well be afforded.

In extreme cases, special cooling by water circulation or forced air may be necessary, but such arrangements are inconvenient, and much can be done by careful design. Useful steps are the employment of polished reflectors or asbestos screens to reduce heat absorption; a massive construction to assure rapid diffusion of heat away from potential hot spots, a large external radiating surface, and planned air circulation with draft induced by fan blades on the shutter.

The most effective device is adequate screening of ineffective light, and this raises a point of importance relating to the dimensions to which the projector aperture is made. If this is to be in sharp focus on the screen, it must be very close up to the film and fully illuminated. Under these conditions, it is bound to absorb a lot of heat, and being difficult to cool, to get rather hot. It would seem preferable to increase the dimensions of the aperture so that it could be screened effectually without loss of light to the boundary of the frame, and to make use of the masking at the screen to black out the resulting vignetting effect around the projected picture, but this system is not liked, the vignetting being objected to.

Mechanical Design

Turning now to the mechanism proper, one is reminded of Kipling's dictum: "There are five and forty different ways of composing tribal lays, and every single one of them is right." One has certain units to couple together—sprocket, shutter, intermittent unit and so forth, the relative dispositions and speeds of which are more or less fixed; how best to gear them up?

Certain considerations must be borne in mind. For convenience of manufacture and service, the intermittent is made as a self-contained, detachable unit. In order to permit of racking the film, provision must be made for movement of the cross box—preferably for rotation of the whole unit, about the axis of the sprocket. The supporting structure must be rigidly designed, since any looseness or vibration is certain to show up in unsteadiness in the projected picture.

Since the timing of the intermittent in relation to the shutter is important, the more direct the gearing between them the better, on account of reduction in inevitable backlash, but this gear train must include some form of differential arrangement to provide automatic compensation for the disturbance in the timing otherwise introduced by the rotation of the cross box.

The commonest and probably the simplest solution is the employment in the gear train coupling together the intermittent and the shutter of a sliding spiral gear moved endwise in step with the cross box.

Some projectors are arranged with a manual adjustment superimposed upon the automatic operation of the compensation movement. This enables fine adjustment of the shutter timing during the show. This complication is, however, of very doubtful practical value, since the timing, once set, should never alter.

When one turns to consider the drive arrangements themselves, one has broadly a choice between trains of gears on parallel axes, or shaft transmission by spiral gears, and a good case can be made out for either system.

A shaft transmission type of layout can be very simple, with only a few gears. This is probably the most inherently silent drive, but due to the considerable sliding action at point of engagement of the spiral gears, friction and wear are increased, involving greater driving power, and adequate lubrication is of great importance.

Whatever the layout, points of importance are rigidly supported accurately located bearings; suitable gear materials, preferably alternate metallic and non-metallic gears with employment of hunting-tooth gear ratios; and adequate lubrication arrangements.

Ample and continuous lubrication is essential if trouble is to be avoided. At the same time, cleanliness is essential, since oil must not reach the film or the sound system. One has alternatives of oil bath construction and "dry type."

Advantages of the "dry type" are greater accessibility and ease of replacement in event of, say, stripping of a gear. Of course, gears should not strip in a well conducted projector, but such disasters do sometimes happen—maybe due to a cleaning rag caught in a shutter or sprocket; maybe dirty oil leading to a seize-up. It is also a cheaper construction, since the problems attendant upon provision of satisfactory oil-tight enclosures are avoided.

Paradoxically, perhaps, the oil-bath machine is inherently the cleaner type; in the "dry" machine, it is difficult to avoid "excess" oil draining out somewhere. Invariably this is traceable to dirt or grease bridging the gap between a spindle and the surrounding catcher, and resulting in a capillary seepage of oil. The obvious remedy is careful cleaning.

Even in a "dry" construction it is usual—indeed necessary—to operate the intermittent unit in an oil bath, the level of which must be maintained. The "oil bath" construction enables a constant flow of filtered oil to this vital and heavily loaded unit, also to all gear contacts, as well as to bearings, with exclusion of injurious dirt and grit, and the only attention required is maintenance of oil level.

Technically, the case for the oil bath construction does appear overwhelming, but in fairness, I must emphasise that well known projectors of dry types have a deservedly high reputation for good service and reliability.

DISCUSSION

Mr. WILKINS : You stated that the illumination of the gate is equivalent to 1 h.p. In modern H.I. lamps, the wattage dissipated is equivalent to somewhere near 10 kW. Where is the disparity between the consumption of the lamp and the concentration on the picture gate?

Mr. ROBERTSON : My figure of 1 h.p. was a rough-and-ready computation based upon the screen size and illumination and the dissipation within the lamp. Of the total lamp dissipation only part is picked up and reaches the screen.

Mr. R. H. CRICKS : Do you think the proposal to build the projector and sound-head as a single unit has sufficient technical advantages to outweigh the obvious commercial defects?

Mr. ROBERTSON : There are obvious technical advantages in combining the two but from the commercial view there are serious drawbacks. Confining one's self to a projector used with a particular sound-head limits the possible market very considerably.

Mr. R. H. CRICKS : Would not a longitudinally guided gate assist in reducing lateral film buckle and possibly reduce the tension needed on the film?

Mr. ROBERTSON : There are definite technical advantages in some curvature of the gate. The film is stiff in the gate and one can apply side pressure rather than by applying pressure on the surface. But optically, from the point of view of definition, it is more satisfactory that the film should be in a plane than that it should be in a curve. If it is curved, it is preferable that the curve should be with a radius on the same side as the lens, as curvature in that direction facilitates the lens designer in obtaining the utmost quality in his lens. Curvature in the reverse direction makes things more difficult optically, because of the natural aberrations of the lens.

Mr. R. H. CRICKS : One could curve the gate above the aperture, leaving the aperture flat.

Mr. ROBERTSON : One has the manufacturing difficulties of combining a radius into a straight plane.

Mr. C. G. HEYS-HALLETT : I must cross swords with Mr. Robertson. Personally, I feel that the days of the separate projector, separate sound-head and separate arc lamp are numbered.

TRAINING AND RESEARCH IN SPAIN

A few months ago mention was made in this Journal of the very extensive programme of the Institute of Kinematographic Researches and Experiments of Madrid (Instituto de Investigaciones y Experiencias Cinematograficas). Further material from the Director of the Institute, Señor Victoriano Lopez Garcia, indicates that its curriculum has been further extended both in the scientific and the

artistic field. The artistic section is particularly well catered for; lectures are given in artistic realisation, literary orientation, history of the arts, etc. Amongst other things, the students have to be familiar with Shakespeare and Bernard Shaw.

For those interested, the detailed programme of the Madrid Institute can be consulted at the B.K.S. library. J. C. C.

USES, CARE, AND MAINTENANCE OF LOW TENSION BATTERIES

J. D. Wright, B.Eng.*

Read to meetings of the B.K.S. Sections at Manchester on February 11, 1947, and Newcastle-on-Tyne on March 4, 1947.

THE most important task which batteries perform in the kinema, is that of supplying the emergency lighting in case of a shut-down of the mains supply. The present seems to be a suitable time to consider how those responsible for the maintenance of batteries can best assure themselves that their emergency lights will, in fact, get an adequate supply from the battery in case of a mains failure.

The Home Office has, since 1934, limited the manner of employing the battery in cinemas by insisting that connection of the battery to the special circuits in case of emergency shall not depend on the operation of an automatic switch.

Battery Arrangement

The usual arrangement for using a battery, therefore, employs a rectifier of comparatively low voltage, usually 50 or 100 volts, which supplies the emergency lights under normal conditions. The battery floats in parallel with the rectifier, neither charging nor discharging. In case of a mains failure, the battery discharges on the emergency load at a slightly lower voltage than the normal one. Since a rectifier presents a high resistance to the discharge current, it is unnecessary to include any reverse current cut-out between the battery and rectifier. Fig. 1 shows diagrammatically the arrangement of the circuit.

The disadvantage of this system is, that if the mains voltage varies, the rectifier voltage varies approximately in proportion. If the mains pressure falls, the battery may begin to discharge on to the load, with the consequence that it may be partially discharged when called on to give a discharge in case of a shut-down. If the mains pressure rises, the rectifier voltage will rise above its normal value and lamps may be burnt out. If any lamps should be burnt out, the consequent reduction in the load will tend to cause a further rise in the rectifier voltage. The relays which illuminate lamps to indicate to the attendant that the battery is discharging usually operate on approximately 25% of the rated output of the rectifier, and, therefore, do not give any indication of a slight discharge current from the battery.

If the mains supply is D.C., a motor generator set, consisting of a D.C. motor driving a low-voltage D.C. generator, can be employed in place of the rectifier.

Constant Rectifier Voltages

These difficulties may be avoided by employing a more elaborate floating system whereby chokes are incorporated in the rectifier circuit so as to maintain almost constant rectifier voltage, irrespective of variations in load current and mains voltage within wide limits.

Later on it may be permissible to employ an automatic switch between the battery and the emergency circuits. If a scheme of this type should become permissible, it would have the advantage that the state of charge of the battery would be independent of the usual fluctuations in mains pressure and the operator could always depend on his battery being fully charged and

* The Chloride Electrical Storage Co., Ltd.

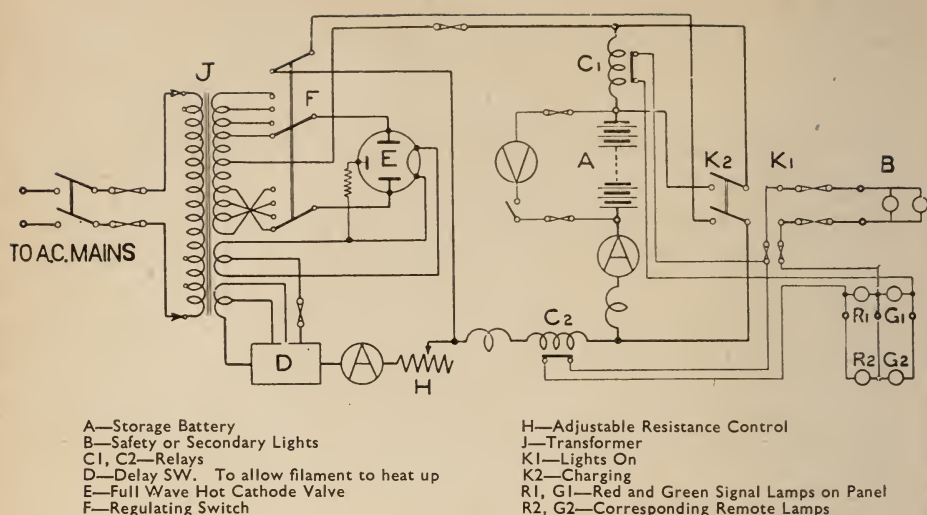


Fig. 1. Floating Battery Emergency System.

ready for emergency use. Furthermore, maintenance would be easier, and also the number of cells could be increased to give a voltage more nearly equal to the normal figure. With this arrangement, the battery on discharge is normally trickle-charged, *i.e.*, it receives a very small charging current, which is sufficient to compensate for the open circuit losses of the cells and to maintain them in a fully charged condition. The current required to do this is approximately one tenth of an ampère for a 100 ampère-hour battery.

In the event of a mains failure, a gravity operated change-over contactor connects the battery to the emergency lighting circuits, which are normally supplied from a step-down transformer. When normal supply is resumed, the contactor is pulled back to its normal position and the battery can then be given charge at a higher rate, to bring it back to the fully charged condition. Fig. 2 shows the circuit employed for this scheme.

Evidently the Home Office was not satisfied that the operation of automatic switches was sufficiently reliable for them to be employed for emergency lighting of kinemas, though equipment of this type is largely employed for emergency lighting in hospitals, large stores, and other places where emergency supply is considered to be necessary. In Scotland the use of an automatic switch for this purpose has been permissible.

At this point the fact may be mentioned that improvements in the manufacture and a reduction in the price of contact rectifiers of the selenium type has led to their more general use, and the hot cathode gas-filled rectifier has tended to go out of use for these equipments.

Construction of Cells

Before dealing with the question of the care and maintenance of these emergency batteries, it would be as well to describe briefly the construction of cells of the type generally employed for this purpose. The positive plates are generally of the Planté type. The separator usually employed consists of a veneer of treated wood which is held between slit dowels which may be of ebonite or of treated wood.

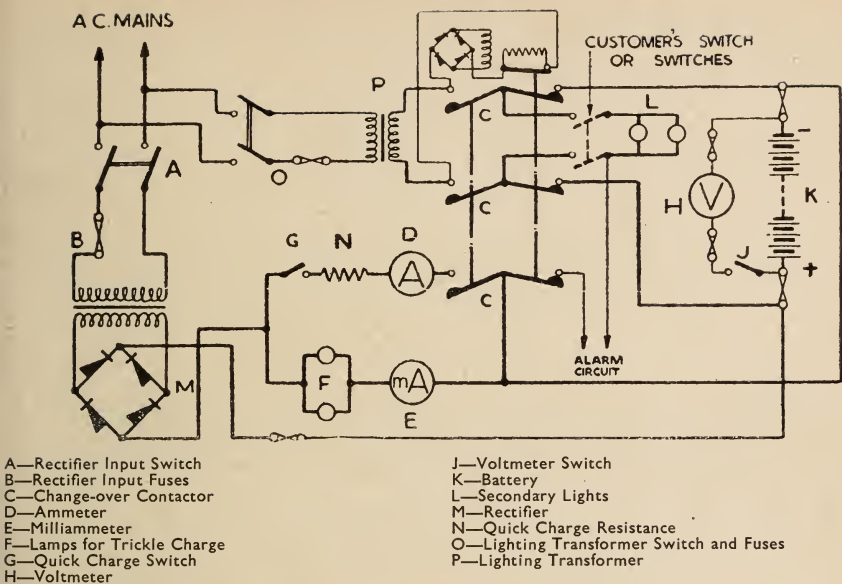


Fig. 2. Emergency Battery connected through Gravity-operated Contactors

The maintenance of a battery in good condition can be divided into four parts :

- (1) Charging.
- (2) Removal of internal short circuits if any should occur.
- (3) Topping up.
- (4) Cleanliness.

Charging

A floating battery should be recharged as soon as possible after an emergency discharge, this charge being continued until the voltage and specific gravity of the acid in a pilot cell have remained constant during one hour's charging. A "freshening" charge should be given once each week, even though the battery has not been discharged. This charge should be continued until the plates gas freely and the specific gravity of the acid has remained constant for one hour.

The necessity to give freshening and equalising charges arises from the fact that a certain amount of local action takes place in the cells while they are idle. The active material of the positive plates (which consists of the coating of lead peroxide which has been formed by electrochemical action on the pure lead casting) reacts with the lead casting to a slight extent, thereby becoming discharged to some extent. The lead sponge which forms the active material of the negative plates also reacts with the electrolyte to a slight extent. The freshening and equalising charges compensate for this slight self-discharge and, what may be even more important, they ensure that if the battery should have become slightly discharged during the week due, *e.g.*, to variations in the mains voltage, it will be brought at least once a week into the fully charged state.

It is advisable to record the specific gravity of each cell at the beginning and end of the monthly equalising charge. If any cell is low in specific gravity and is backward in gassing, this will probably be due to the presence of an internal short circuit. Nearly all batteries used for emergency lighting are fitted with wood separators and internal short circuits should be of very rare occurrence. It is possible, however, for a wood separator to be

displaced in transit or to be damaged when inserting a hydrometer syringe or funnel into the cells. Any trouble of this sort should be cleared immediately by unsealing the cell and removing the cause.

The addition of water to the cells is necessary to compensate for loss by evaporation and by electrolytic action during charge. When the cells gas at the end of charge, the hydrogen and oxygen which form the gas bubbles result from splitting up part of the water in the electrolyte, and this loss must be made good.

Topping up of the cells should in most cases only be necessary about once a month in the case of floating batteries. It is important that only distilled water or water which the battery manufacturer has approved should be added to the cells.

Battery Maintenance

The electrolyte, dilute sulphuric acid, has the property—unfortunate in this case—of attacking most of the common metals. Iron, copper and brass are all attacked by it. It is nearly always the case that bolted connections between cells are employed in emergency batteries to simplify erection. The steel nuts and the heads of the steel bolts employed to make these connections are usually protected against the action of the acid by being encased in sheaths of antimonial lead. Provided that the connections are greased with petroleum jelly at the time of erection and the coating of grease renewed when necessary, little trouble should be experienced due to corrosion of the nuts and bolts.

The connecting straps and pillars of the cells may be either of pure lead or hard antimonial lead. Pure lead tends to flow under continued pressure and therefore these connections may in time become loose. Periodic tightening up of such connections is therefore necessary to avoid the introduction of a high resistance into the battery circuit, in cases where soft lead straps or pillars are used.

Still another possibility of bad contact at the cell terminals exists, due to the fact that a hard film of lead sulphate tends to form on the positive pillars of the cells. It is, therefore, advisable occasionally to clean up the contact surfaces of the positive pillars of the cells with a rasp or file to expose the surface of the lead. After such attention, the contact surfaces should be smeared with petroleum jelly to delay further action on them. Such action is only necessary at comparatively long intervals.

Batteries for Exciter Supply

Another use of batteries in some kinemas is to furnish supply for the exciting lamps and for valve filaments in the amplifiers or for speaker coils. These batteries are usually made up in 3-cell, 6-volt units, and are employed on a regular system of charge and discharge. These batteries may employ positive plates of the Ironclad or of the flat plate type. Cells of the Stationary type with Planté positives may also be employed.

The semi-portable batteries employing Ironclad or flat pasted positives, usually have solidly burned intercell connectors so that maintenance of bolted connections is restricted to the end terminals. These cells, which are deeply discharged and fully charged and gassed probably once in every 24 hours, will naturally require more frequent topping up than emergency batteries which require a gassing charge only once each week. A fortnightly equalising charge is recommended.

The rate of accumulation of sediment in reproducing batteries is also greater and arrangements should be made to have the cells cleared out before the sediment reaches the tops of the supporting prisms and bridges across the lower edges of the plates.

As with many other items of equipment, regular attention is necessary to the battery if it is to give satisfactory service.

B.K.S.—S.M.P.E. CO-OPERATION

Mr. A. G. D. West, M.A., B.Sc., Hon. F.B.K.S., Past President of the B.K.S., was invited by the S.M.P.E. to attend their Autumn Convention, held last October in New York, and did so as official B.K.S. representative. He presented two Papers at the Convention.

During the Convention and subsequently Mr. West conferred with the President and Officers of the S.M.P.E., and discussed the possibilities of greater co-operation between the two Societies. He found the S.M.P.E. very receptive to proposals which covered the exchange of papers and journals, regular correspondence on new technical developments and exchange of information on standards.

Mr. West reported as follows to the Council of the B.K.S. on his return to this country :

Exchange of Papers and Journals

It was thought to be desirable that each Society should have an opportunity of publishing the papers of the other Society. There should be a selective consideration on each side, with each Society reproducing the other's paper, either in full, or in abstract.

It had been previously suggested by the President, B.K.S., that it might be advantageous to both Societies if the full membership of each could receive the other's Journal. Such an arrangement, at the moment, was impracticable, due to paper shortage and cost. It was, therefore, agreed that it would be sufficient if arrangements could be made for an exchange of journals between Society officers.

Circulation of Correspondence

Personal co-operation and correspondence between Society officers would be a valuable means of maintaining contact, not only on Society matters, but on technical developments in either country. Although much is

covered by exchange of journals, and by reading technical papers on either side, the introduction of a personal element would be valuable in maintaining friendship and exchange of information.

This could best be done by circulating a correspondence file in which each correspondent would write notes regarding technical developments, or submit questions on technical points, to be answered and commented on by subsequent contributors. Such a file could travel across the Atlantic, perhaps once a month. A summary of the correspondence would be circulated by the Secretaries of each Society to Society officers, and, if necessary, to Society members.

Exchange of Information on Standards

It was further agreed that the Societies should keep in touch on the initial and subsequent stages on any matter that is to be the subject of standardisation, to ensure parallel action in motion picture standardisation by A.S.A. and B.S.I.; and that a monthly letter should be sent by the Engineering Secretary of the S.M.P.E. to the B.K.S., and a similar monthly letter should be sent by the Secretary of the B.K.S. to the S.M.P.E., giving a brief statement on what is happening on each side of the Atlantic in respect of standardisation.

The suggested change-over of projection speed to 30 frames per second, flicker in film and television projection, and international standardisation in television, were subjects also discussed at these meetings between S.M.P.E. representative officers and Mr. West.

Mr. West concluded his report by expressing appreciation of the extremely friendly reception he had received.

The above arrangements were ratified at the meeting of the B.K.S. Council on December 10th, 1947.

UNESCO FILM PRODUCTION UNIT

The working party of the Mass Media Section of the Unesco Conference at Mexico City, adopted a United Kingdom resolution that Unesco create a production unit to prepare and distribute information

through various media, one being the film, on subjects of an educational, scientific and cultural nature. Such a unit should include directors and script writers in film production.

TECHNICAL ABSTRACTS

*Certain of the following abstracts are reprinted by courtesy of Messrs. Kodak Ltd.
Most of the periodicals here abstracted may be seen in the Society's Library*

THE MECHANISM OF PHOTOGRAPHIC DEVELOPMENT : A REVIEW OF THE WORK OF T. H. JAMES. PART I.

R. B. Collins, *Phot. J.*, **87B**, January-February, 1947, p. 2.

The work of T. H. James on the reduction of (a) silver ions, (b) insoluble metal salts, has been reviewed. The evidence supports the view that normal photographic development is a silver catalysed reaction occurring at the silver-silver halide interface. The importance of an ionic protective layer of adsorbed ions is also stressed AUTHOR'S ABSTRACT.

DETERMINATION OF ELON AND HYDROQUINONE IN DEVELOPER. AN EXAMINATION OF STOTT'S METHOD.

G. I. P. Levenson, *Phot. J.*, **87B**, January-February, 1947, p. 18-24. (Kodak Communication No. 1116H.)

The method for the determination of Elon and hydroquinone published by Stott has been found to give low results. The method has been examined in detail and the causes of a number of errors have been located. Methods of eliminating some of these and of compensating for others are described. Details of the experimental technique, including the selection of a suitable indicator, etc., are discussed. Summarised schedules of operations for carrying out the determination of hydroquinone and Elon in a developer containing both, and Elon in a developer containing only Elon, are appended. Using the modified technique the concentrations of Elon and hydroquinone may be determined to within two per cent. of their true value.

AN ANALYSIS OF LOW-REFLECTION COATINGS AS APPLIED TO GLASS.

W. P. Strickland, *J. Soc. Mot. Pic. Eng.*, July, 1947, p. 27.

The author summarises the advantages and principles of anti-reflection coatings and the reason for the colour. He describes a technique whereby a colourless coating can be obtained by means of a continuously variable refractive index. He concludes that the magnesium fluoride coating is the most satisfactory and shows that this protects the glass from chemical abuse. He describes a new method of removing the coating if necessary. M. V. H.

A COMBINATION SCORING, RE-RECORDING AND PREVIEW STUDIO.

D. J. Bloomberg, W. O. Watson and M. Rettinger, *J. Soc. Mot. Pic. Eng.*, July, 1947, p. 3.

The various considerations affecting the acoustic design, recording equipment and detail layout of the new Republic scoring studio are discussed and a description of the scoring and rerecording facilities is given with photographs of the installations. N. L.

A NEWLY DEVELOPED LIGHT MODULATOR FOR SOUND RECORDING.

G. L. Dimmick, *J. Soc. Mot. Pic. Eng.*, July, 1947, p. 48.

The new RCA mirror galvanometer is interchangeable with and follows the same general design as those at present in use. Performance figures for the improved frequency response and freedom from harmonic content and bias effects, are given. The improved performance and stability has been achieved at the expense of a reduction in sensitivity which is well within the capacity of amplifiers now being introduced. N. L.

SOUND ABSORPTION AND IMPEDANCE OF ACOUSTICAL MATERIALS.

Hale J. Sabine, *J. Soc. Mot. Pic. Eng.*, Sept., 1947, p. 262.

The paper reviews the relationship between acoustic-impedance and sound absorption and notes the influence of the physical properties of a medium on these factors. The application of these concepts to practical cases is then dealt with, including the behaviour of both solid backed and air spaced panels. N. L.

THE COUNCIL

Meeting of 10th December, 1947

Present : Messrs. I. D. Wratten (*President*), E. Oram (*Hon. Secretary*), P. H. Bastie (*Hon. Treasurer*), C. Cabriol, R. B. Hartley, B. Honri, A. W. Watkins, A. G. D. West (*Past President*), R. Pulman (*representing Theatre Division*), H. S. Hind (*representing Sub-Standard Division*), G. Burgess (*representing Film Production Division*), and R. H. Cricks (*Secretary*).

Library.—It was felt desirable to make duplicate copies of library books available, on long term loan, to the Newcastle Section Library.

Polytechnic Course.—The request of two prospective Students for admission to the Polytechnic Course was referred to the Polytechnic Advisory Committee.

Foreign Relations Committee.—A meeting of the Committee on the 4th November, 1947, was reported. Contacts had been made with technical bodies in fourteen different countries.

Film Mutilation.—The appointment of a committee was confirmed, to consist of representatives of the B.K.S., the K.R.S., and the C.E.A., to prepare and publish brochures on film mutilation.

Branch Constitution.—It was agreed on the recommendation of the Theatre Division Committee, that the Manchester branch should include the areas of two C.E.A. Branches, Manchester and Salford and District, and south-east Lancs.

Proposed Leeds Branch.—The proposed formation of a Leeds branch was discussed, and a committee suggested, and approved.

Proposed Indian Branch.—Letters from Indian members concerning the possibility of forming a branch of the Society in Bombay were read.

Film Production Division.—Following discussion, it was agreed that matters concerning television production should be the concern of the Film Production Division until such time as it was deemed expedient to form a Television Division. It was agreed to co-opt Mr. L. R. Johnson to the committee.

EXECUTIVE COMMITTEE

Meeting of 10th December, 1947

Present : Messrs. I. D. Wratten (*President*), P. H. Bastie (*Hon. Treasurer*), E. Oram (*Hon. Secretary*), R. H. Cricks (*Secretary*).

Elections.—The following were elected :—

ALBERT MORRELL MIDGLEY, A.M.I.E.E. (Member), Midgley Harmer, Ltd.
 DAVID WHITEHEAD BOSTON, B.Sc., A.M.I.E.E. (Associate), British Acoustic Films, Ltd.
 RONALD WEMYSS BAKER (Member), Walturdaw Cinema Supply Co., Ltd.
 BALFOUR ALEXANDER RICHARDS (Member), Palace Amusement Co. (1921), Ltd., Jamaica.
 DAVID VICTOR MOTTURE (Associate), British Lion Studios.
 RONALD GEORGE ETHERINGTON (Student), Worton Hall Studios (1944), Ltd.
 MISS DORIS KOEGLER (Associate), Gainsborough Pictures (1928), Ltd.
 LASZLO NAMENYI KATZ (Member), Edsylon Research and Development Co.
 JOHN ANTHONY CLARK GIBSON, M.A. (Associate), Gaumont-British Equipment.
 HENRY THOMAS ORTEN (Student), Polytechnic, Regent Street.
 JOHN CONNOR (Member), Bensham Picture House, Gateshead-on-Tyne.
 FRANK GEOFFREY WOOSNAM-MILLS (Member), Producer-Cameraman.
 LESLIE RAY DENNIS (Associate), British Movietone News.

Journal.—It was agreed that the Journal should not be sent to a member in arrears with his subscriptions for a period of three months. It was pointed out that in such a case a member was, under the By-laws, not entitled, on payment of arrears, to any back issues of the Journal.

ABOLITION OF PURCHASE TAX ON PROJECTOR LAMPS

We have now been informed by H.M. Customs and Excise that Class A.1 and Class G. Projector Lamps have been freed

from Purchase Tax, even where of 250-watts and below. This reverses the decision announced last month.

BOOK REVIEW

GRID SYSTEM STEREOSCOPY IN THE KINEMA, by Ivanoff (Moscow).

The book recently published in Russia is a textbook on stereoscopy, mentioning all the well-known systems. The book also describes a special stereoscopic system developed by the author in which, broadly speaking, he takes a standard 35 mm. film and instead of using four perforation holes per picture he only uses one perforation hole per frame. In addition, instead of the usual single picture across the film he takes two smaller nearly square pictures which extend into the normal sprocket hole area and are separated by the sound track, which is positioned between the two pictures in the centre of the film (see Fig. 122 in the book).

There are no special attachments for the viewer when the film is projected, but the screen employed uses a lenticulated grid system.

From other publications available it appears that this system is installed in a small kinema in Moscow having a seating capacity of 200. Apparently, however, the question of sufficient light is important and from latest reports it seems that the Russians have now gone over to using two standard films which are run in synchronism.

The Russian proposal is interesting and shows practical results, but, as already mentioned, only for a small kinema. It is very doubtful whether in any larger kinema the amount of light would be sufficient.

It is also very interesting to note that as so often happens, Ivanoff's idea is really a re-invention of a previous idea. A comparison of French Patent Specifications Nos. 666361 of Edmond Noaillon filed in 1928 and 885032 of S. Pavlovitch Ivanoff filed in 1940, shows that Noaillon had put the same idea on paper twelve years before Ivanoff.

O. K. KOLB.

BRITISH STANDARDS

Three British standards specifications of photographic interest have recently been published:

B.S.1404 : 1947—Measuring Apparatus for Photographic Processing.—Specifies the types of volumetric measuring apparatus, balances, scales, weights and thermometers, that will give the accuracy required for photographic processing as economically as possible. Recommends preferred types of volumetric measuring apparatus.

B.S.1409 : 1947—Letter Symbols for Electronic Valves.—The letter symbols laid down in this standard apply to electrodes and other components of electronic valves, designations of different types of valves and electrical quantities in connection with valve technique. They are intended for use by valve manufacturers and users and in technical literature generally.

B.S.77 : 1947—Film-Strip and Film Slides.—This British Standard applies to 35mm. safety films for use in still-picture projectors and to sub-standard slides. It specifies all essential dimensions, together with the arrangement of images, leaders and trailers, and position indicators.

PERSONAL NEWS of MEMBERS

Members are urged to keep their fellow members conversant with their activities through the medium of the Journal.

D. W. ALDOUS, a director of Waldens Films, Ltd., Hon. Technical Secretary of the British Sound Recording Association, has recently opened a sound recording studio in Torquay, to be known as Rosener's Recording Studio.

F. A. CAM has been appointed by Sound Equipment, Ltd., to handle the sales of all B.T.H. 35mm. and 16mm. equipment in South Wales, and the West of England.

P. J. GEORGE, R.A.F., formerly of the Canadian Air Force, is at present in Ismailia.

A. J. PINCOMBE of G. B. Equipments, has been chosen as first chairman of the newly formed Sub-Standard Technical Committee of the K.M.A.

E. SADLER, no longer employed by W. Vinten, Ltd., has joined Newman and Sinclair of Highgate.

J. B. SAUNDERS of Unifilm Studio, Ltd., London, has been advised to rest, and for the next six months will be convalescing on his back.

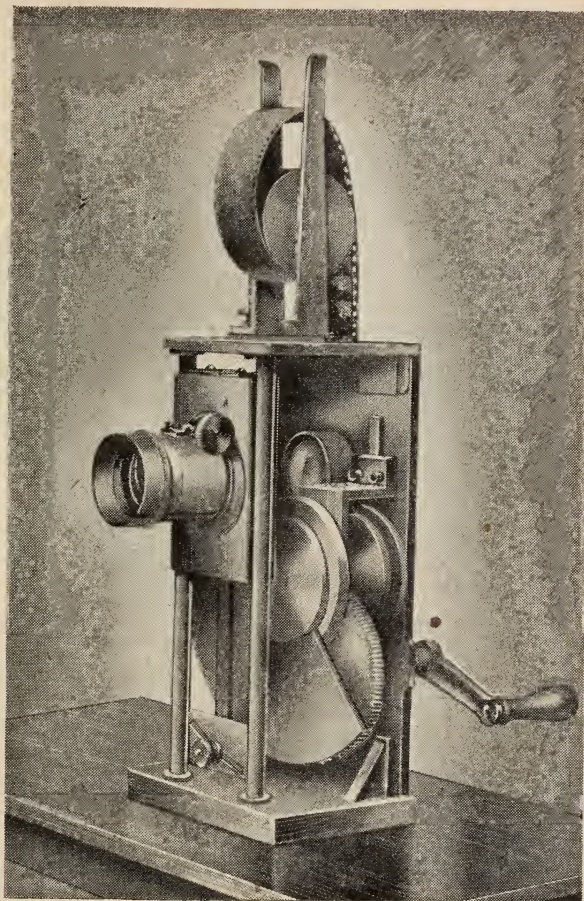
ALAN WILLIAMSON has recently celebrated fifty years in the film trade.

The President of the Society has congratulated Sir Michael Balcon on the knighthood conferred upon him in the New Year Honours List.

16mm. KODACHROME OF ROYAL WEDDING

The 16mm. Kodachrome record of the Royal Wedding, exhibited in London several days before the run of the 35mm. rival, was made by Victor S. Piercey and R. H. Hollyman.

Lumière projector
used at London Polytechnic,
20th February, 1896

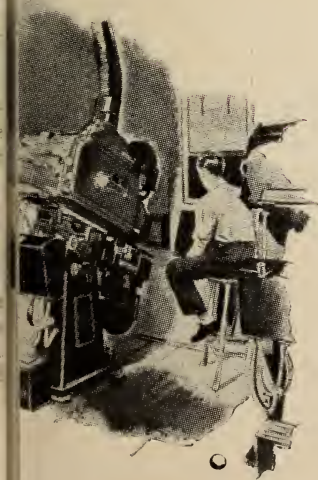


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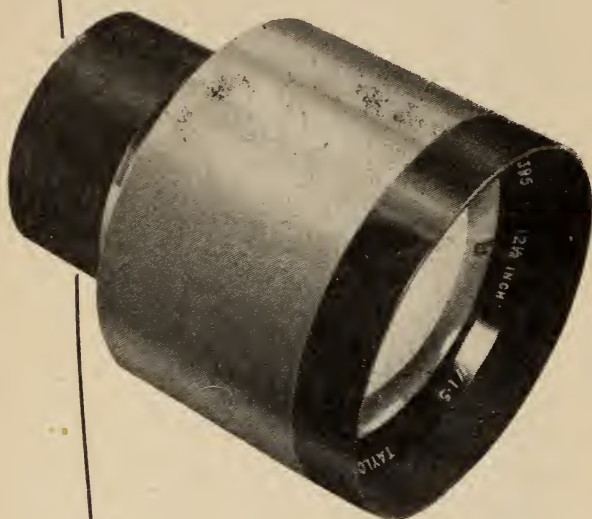


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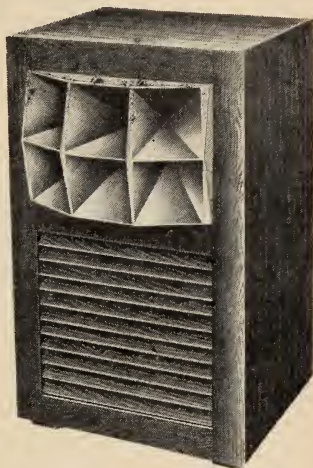
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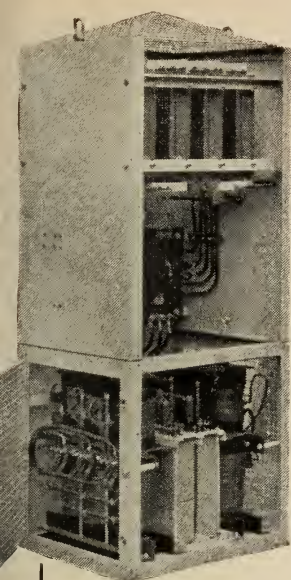
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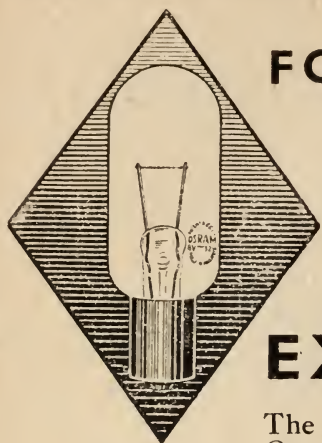


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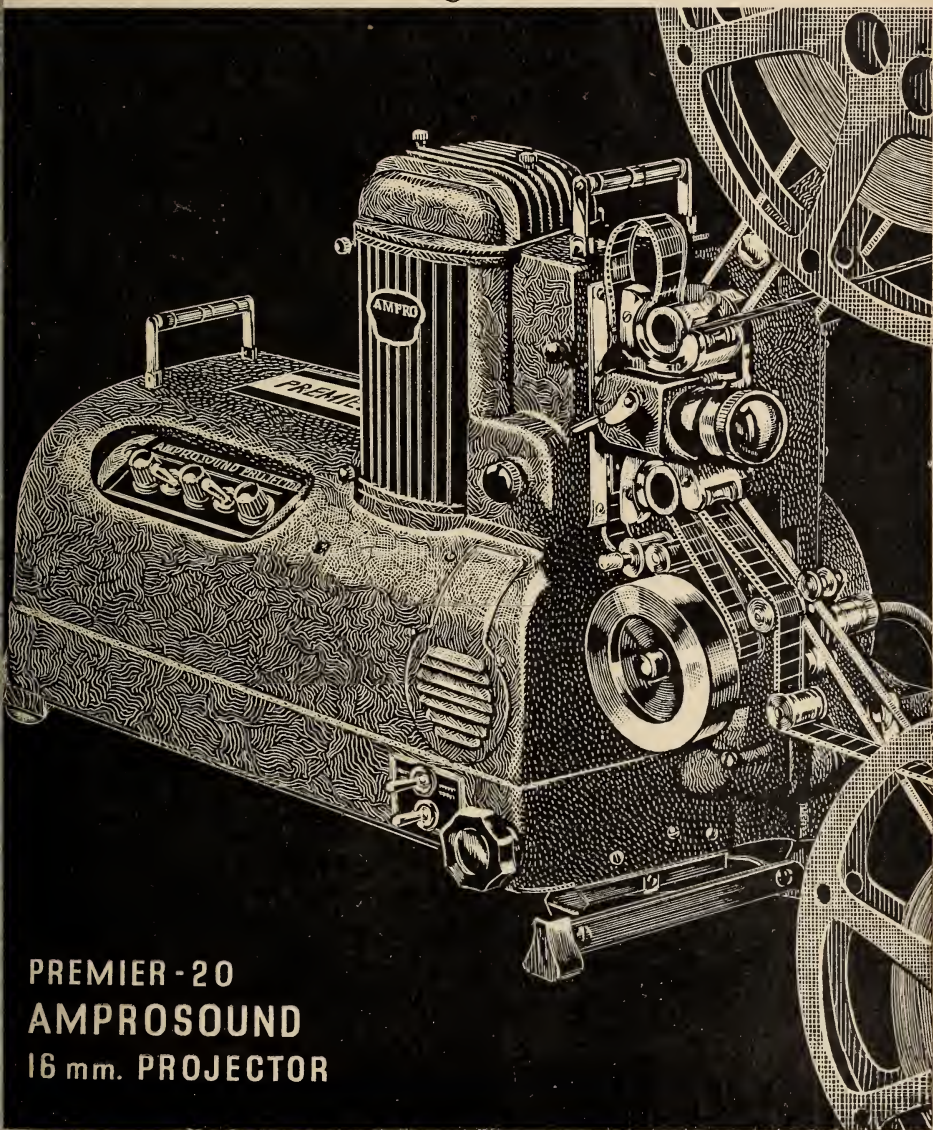
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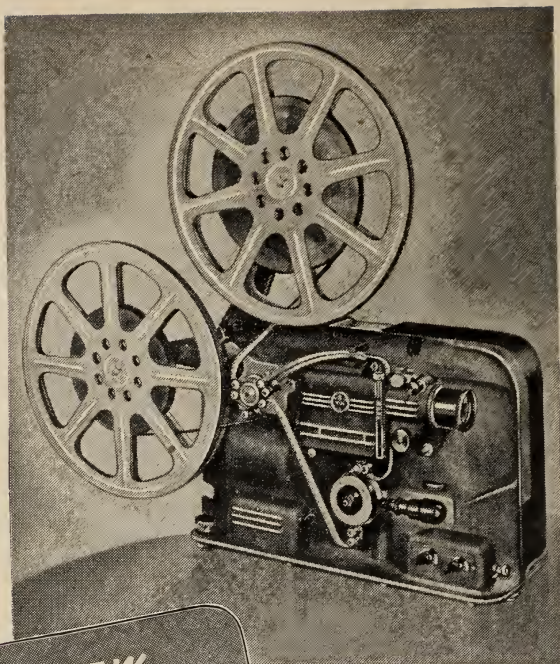
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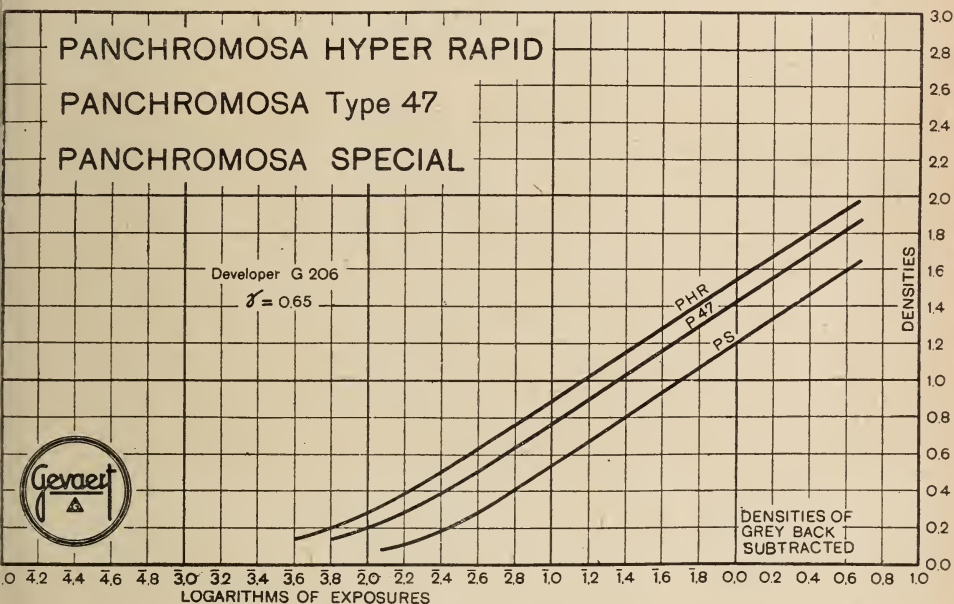
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BRITISH KINEMATOGRAPHY

The Journal of the British Kinematograph Society

VOLUME TWELVE, No. 2.

FEBRUARY, 1948

CONTROLLING THE ELON-HYDROQUINONE DEVELOPER

G. I. P. Levenson, Ph.D., B.Sc.*

Read to the British Kinematograph Society on October 8, 1947.

THE would-be controller of the Elon-hydroquinone developer hopes to do three things. He wants to achieve a correct sensitometric performance so that his developer gives the correct gamma, emulsion speed and fog in a convenient time; to maintain this performance with the minimum of deviation; and to do these things with the greatest possible economy in time and materials. As developers go, the Elon-hydroquinone solution is comparatively manageable, but it is still sufficiently unpredictable to cause much worry on the part of the controller.

I. SENSITOMETRIC AND ANALYTICAL CONTROL

It is easy for the controller to tell what the current performance of his bath is, simply by processing a sensitometric strip. This photographic method of current assessment cannot be improved upon by chemical means. However, this photographic assessment is only an uncertain method of predicting what the bath will be doing tomorrow or in a few hours' time. A straight line on the sensitometric control chart tells the controller only that he has been successful up to date and gives no hint of a possible collapse of the bath in the near future.

Chemical Changes in Bath

This is especially the case in the first week or so after installing a new bath. For example, if a new D76 bath is installed in a system where it is circulated and exposed to air, it can be used extensively without replenishment and will appear to become more and more active and may even necessitate a reduction in development time. Then suddenly it will collapse.

The cause of this phenomenon becomes obvious when one follows the chemical changes in the composition of the bath. A negative bath is not severely exhausted by the normal negatives that are developed, and the acid liberated in the reduction of silver halides is not sufficient to counter the tendency for the alkalinity to increase as hydroquinone is oxidised atmospherically in the presence of sulphite. Since the buffering of the D76 type

*Research Laboratories, Kodak Ltd.

bath is poor the pH rises, and this rise is usually more than enough to maintain or even increase the rate of development in spite of a fall in the developing agent concentration. This process continues until all the hydroquinone is consumed, and then the drop in Elon concentration becomes more rapid and the bath collapses. Therefore, if one wants to operate a bath continuously, it is highly desirable to gain some knowledge of the trend of the chemical changes that take place. For this and for other reasons, there has been a marked tendency in recent years to introduce chemical analysis as a routine practice in motion picture laboratories.

Application of Chemical Analysis

This paper is primarily addressed to the controllers who use, or who contemplate using, analytical methods; and one of its objects is to draw attention to the fact that the carrying out of chemical analyses on the baths is not always followed by an improvement in the quality and consistency of the product. There is a great virtue in "leaving well alone," and some laboratories who have established consistent procedures after many years of patient trial and error methods are quite likely to find that chemical analysis can lead to no improvement.

Some laboratories prefer to instal a fresh negative bath, to use it until it shows signs of deteriorating, and then to discard it, rather than to attempt to maintain it for a long period. In this case, the most useful purpose to which analysis can be put, apart from being used as a check on the accuracy of the mixer, is to enable the pH to be adjusted, because negative baths are rather sensitive to pH changes. The most important application of chemical analysis is, however, in connection with baths that are to be continuously maintained and which are difficult to control photographically. Most laboratories attempt to maintain a positive bath for a long period and some to maintain a negative bath.

The controller who uses analytical methods requires also to know the effect on the performance of the bath of a given change in the concentration of one, or more, of its constituents in order that the analytical data may be used to best effect. Without this knowledge, the best that he can hope to do is to maintain the composition of the bath constant according to the formula that experience has shown to give satisfactory results. However, it is unlikely that the controller will know whether the bath formula established at that laboratory by trial and error could be modified without disadvantage to a more economical mix, because few laboratories can spare machine time to carry out such experiments.

Elon-Hydroquinone Ratio

Not much help in this direction can be obtained by reference to the literature. For example, the work of Frötschner¹ and Shiberstoff² led these authors to conclude, that only slight modifications in performance could be achieved by changing the Elon/hydroquinone ratio within wide limits. On the other hand, practical experience seems to indicate that increasing the hydroquinone concentration in a positive bath helps to increase the gamma obtained in given time of development.

A systematic study was therefore undertaken of the Elon-hydroquinone developer to find the influence on the performance of the developer of changes in the Elon/hydroquinone ratio, and in the concentrations of sulphite and bromide, and in the pH . By performance is meant the behaviour of the bath with respect to sensitometry, oxidation by silver bromide, and oxidation by atmospheric oxygen. The work on aerial oxidation is not yet

complete, but the parts of the work relating to sensitometry and to development oxidation have now been completed, and have yielded some interesting information relating both to the behaviour of the developer and to the chemistry of its mode of action. The work is to be published in detail in the appropriate journals and in a paper of this nature there is time to refer only to some of the data obtained.

II. THE MECHANISM OF THE ELON-HYDROQUINONE DEVELOPER

Before going on to discuss the data obtained, an outline will be given here on the conclusions reached in this work regarding the mechanism of the Elon-hydroquinone developer³. This is done not because it will be of immediate practical use to the laboratory controllers, but rather in the hope that it will provide a thread on which the data and relationships to be described below may be strung together.

The most important conclusion to be drawn from this work, was that the Elon-hydroquinone developer shows a phenomenon of super-additivity when

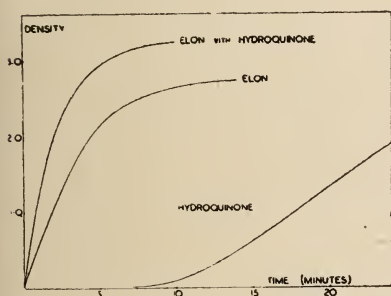


Fig. 1. The course of development of motion picture positive film (exposed to the 17th step of the Eastman IIB sensitometer) when treated at pH 10.0 in the following developers: 0.032 M Hydroquinone (lowest curve), 0.008 M Elon (middle curve), and 0.008 M Elon plus 0.032 M hydroquinone. At any level of density, the slope of the Elon-hydroquinone curve is greater than the sum of the slopes of the other two.

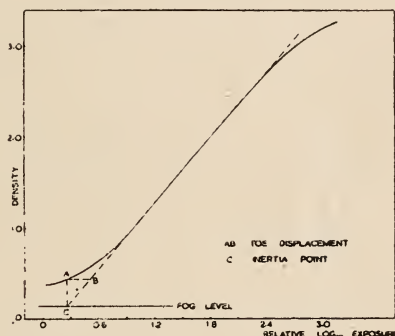


Fig. 2. The length of the toe of the characteristic curve is measured by the Log E displacement (AB) of the curve from the straight line at the Inertia point.

one considers rates of development. In Fig. 1 the density of a given exposure step on a piece of film is plotted against time of development. One curve shows how the density grows in a hydroquinone developer, and the other curve shows how the density grows in an Elon developer. The third curve, standing well above the other two, shows how the density grows in a developer which contains the same amounts of Elon and hydroquinone that were present in the separate developers (other things being maintained equal). It will be seen that at a given stage of development, that is at a given density, the rate of development in the Elon-hydroquinone developer is greater than the sum of the rates of development in the separate Elon and hydroquinone developers.

This super-additivity phenomenon, which is the basis of the superiority of the Elon-hydroquinone developer, results from a two-stage development process. The Elon is, in fact, the active developing agent. This reacts with the silver bromide and becomes oxidised. In the normal way, in the absence of hydroquinone, the oxidised Elon would be converted to Elon sulphionate by reaction with the sulphite in the developer. However, when hydroquinone is present, the hydroquinone regenerates Elon by reducing

the oxidised Elon before this latter can be sulphonated. The oxidised hydroquinone forms hydroquinone sulphonate by reacting with the sulphite. In other words, the function of the Elon may be described as that of an intermediary between the hydroquinone and the silver bromide, carrying electrons from one to the other. As the alkalinity of the developer is increased, the reduction potential of the hydroquinone increases more rapidly than that of the Elon and, therefore, as the alkalinity increases, the most active combination of Elon and hydroquinone will contain less and less Elon.

III. EXPERIMENTAL CONDITIONS

In the motion picture field the Elon-hydroquinone developer is used for processing both negatives and positives. Different formulae are used for

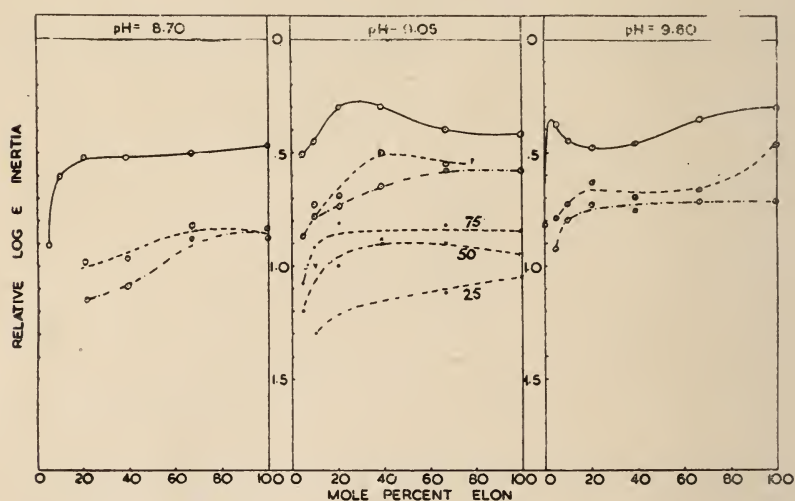


Fig. 3. The Log E value of the Inertia point for negative film at a gamma of 0.65 is plotted as a function of the molar percentage of Elon in the total quantity of developing agent (0.057 M) in the negative type developer. No bromide, solid curves; 1g. per litre KBr, — — —, 2g. per litre KBr, — · — · —. Series in which the sulphite concentration was varied from the normal 100 g. per litre are indicated by the appropriate concentration numbers, e.g., $\frac{75}{100}$.

these two purposes, but the essential difference between them is to be found in the pH value. Negative developers have a pH value of about 9.0 and positive developers have a pH value of 10.0—10.5. There are secondary differences in the sulphite and bromide concentrations. In order to carry out a survey of the properties of the Elon-hydroquinone developer, it was necessary to find a typical formula to work on.

Developer Formulae

In the case of negative developers the choice was easy, because almost all laboratories use a developer of the type of D76, the formula of which is :

	Grams	Moles	
Elon	2.0	.0116	} total developing agent = .057 M
Hydroquinone	5.0	.0454	
Sodium sulphite (anhyd.)	100		
Borax	2.0		
Water	1 litre		

In the case of the positive developer the choice was not so easy. The classical motion picture positive developer was the D16. However, since the introduction of continuous processing and continuous replenishment, this formula has been largely abandoned. Even in those cases where the initial mix is made according to the D16 formula, the equilibrium formula of the bath is quite different. The chief variation in the positive bath formulae used at the various motion picture laboratories lies in the Elon/hydroquinone ratio and in the general level of concentration. The following arbitrary formula was chosen as being a reasonable representative of the various formulae used :

Developing agent	...	...	...	.04 moles*
Sodium sulphite (anhyd.)	...	...	...	37.8g.
Sodium carbonate (anhyd.)	...	...	...	21.2g.
Water to	...	...	...	1 litre

*e.g., 4.40 g. hydroquinone or 6.88 g. Elon in the extreme cases.

The pH and bromide concentrations were adjusted as required.

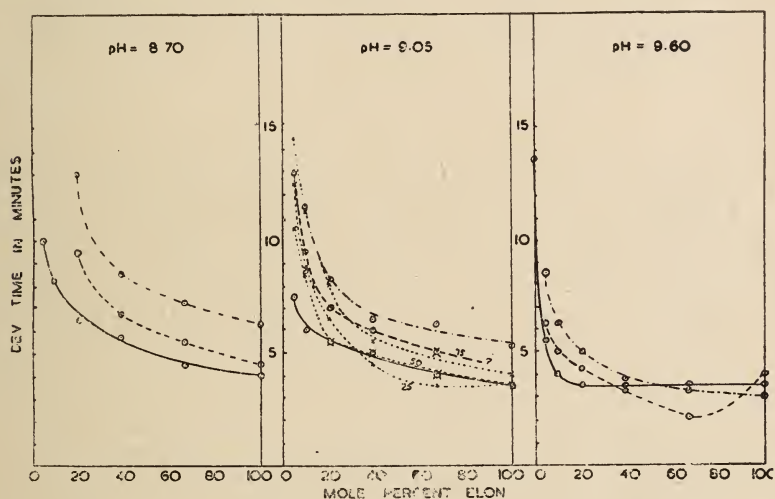


Fig. 4. The time taken to reach gamma 0.65 is plotted as in Fig. 3 against Elon proportion.

Variation of Alkalinity

Such were the basic Elon-hydroquinone developer formulae upon which the survey was made. In carrying out the work the Elon/hydroquinone ratio was varied at various levels of pH. The experiments were repeated using other levels of bromide concentration, and again at other sulphite concentrations. The developers were tested with Plus X negative film and with positive film type 1301. Parallel results were obtained throughout, showing that the influence of the composition of the developer on its performance is largely independent of the type of emulsion used.

However, in the limited space now available, reference will be made only to the results for (a) negative developers with negative film and (b) positive developers with positive film.

IV. SENSITOMETRIC CRITERIA

The next problem was to select suitable sensitometric criteria by which to assess the results. Anyone who has worked in this field will know that this is not such an easy task as it seems at first sight.

Because gamma is the most important factor in a tone-reproduction system, it is proper to consider all other characteristics at a given gamma value. Fortunately, in the motion picture field the gamma values used for negatives and prints are fairly narrowly prescribed. The overall gamma from subject to print should be approximately 1.3, that is the product of negative and positive gammas should have this value. The negative gamma is usually 0.65; it varies in practice usually from 0.6 to 0.7. The print gamma is usually just over 2.0 in the case of type 1301 film. The two sensitive materials used in this work give characteristic curves with well defined straight line portions and the gammas may be readily ascertained.

It is of great importance, especially when making the original negative, that an image with the correct gamma and density should be obtained with a minimum of exposure. The sensitivity of a photographic material is determined both by the properties of the emulsion and by those of the developer used, but we are concerned here only with the effects due to the developer. No account is necessary here of the pitfalls that beset the determination of emulsion speed. In the present work, the method of inertia speed was selected. Since a fixed gamma was to be used, the inertia speed method would indicate the lateral displacement of the characteristic curve with respect to the log E axis.

Toe Shape

The question of sensitivity is also bound up with the shape of the toe of the characteristic curve. The shape of the toe of the positive material is also of importance in that it affects the reproduction of fine tones in the highlights of the picture. A reproduction of an original subject of wide brightness range appears harsh when seen on the screen if the photographic characteristics are nearly linear. In fact, the highlights need a reproduction of lower contrast than the medium and dark tones. Any method of quantitative assessment of the shape of the characteristic curve must be arbitrary in some degree. In the present work the shape of the toe is expressed numerically as the log exposure separation of the curve above the inertia point from the extended straight line. This is illustrated in Fig. 2, where C is the inertia point and AB is the log E separation of the curve from the straight line. This quantity AB will be referred to as the Toe Displacement.

Two important properties of a developer remain to be considered. These are its rapidity of action in producing the desired gamma and the fog level that it creates.

Mode of Procedure

Sensitometric strips exposed on the IIB sensitometer were developed for increasing times in any one developer so as to obtain a family of characteristic curves. Development was carried out at 20° C. under conditions of vigorous agitation. When the processed strips had been measured, curves could be derived showing the relationship between gamma and inertia speed, toe displacement, fog, and time of development, etc.

V. RESULTS OF EXPERIMENTS

The results obtained according to these criteria can be seen in the following figures.

Inertia Speed for Negative Film

Fig. 3 shows the inertia speed for the negative film at a gamma of 0.65 as a function of Elon and hydroquinone proportion. The inertia speed

reaches a maximum or an optimum value at a fairly low proportion of Elon. It is interesting to note that this assessment confirms the selection of the D76 formula for giving high speed. The addition of bromide, shown by the dotted curves, greatly reduces the speed obtainable at all three pH levels and at all Elon/hydroquinone ratios. Reducing the sulphite concentration at pH 9.0 also reduces the inertia speed.

Rate of Development for Negative Film

The time of development required to reach the gamma value of 0.65 is shown in Fig. 4 and decreases with increasing proportion of Elon.

Inertia Speed for Positive Films

The critical gamma was taken at the rather low value of 2.0 in order to include as many data as possible in the assessment. This does not affect the

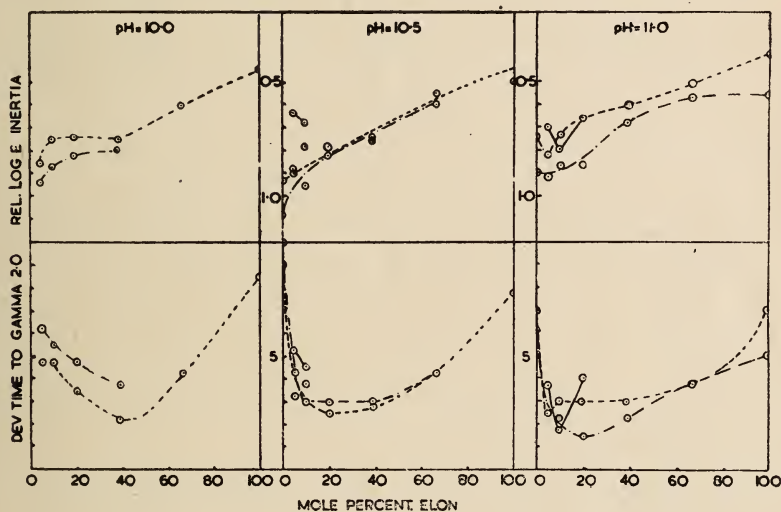


Fig. 5. The Log E value of the Inertia point and the time of development, for positive film at a gamma of 2.00, are shown as a function of the molar percentage of Elon in the total quantity of developing agent (0.04 M) in the positive type developer. No bromide, solid curves; 1g. per litre KBr, —.—.—; 2g. per litre KBr, —.—.—. Note: at pH 10.0, with 2.0g. per litre of KBr, the critical gamma could be reached at a certain time of development and again, with greater emulsion speed, after a longer development when the increasing fog had caused the gamma to decrease after an optimum value had been reached.

general picture. The inertia speed shown in Fig. 5 increases markedly with increasing proportions of Elon. In the absence of bromide the critical gamma can only be reached at low Elon/hydroquinone ratios.

Rate of Development for Positive Film

The time of development required to reach a gamma of 2.0 is shown in Fig. 5. It reaches a minimum value at a proportion of Elon that decreases with increasing pH, in keeping with the mechanism outlined earlier.

Toe Displacement

Examination of the figures for the toe displacement shows that at a given gamma the toe displacement is independent of the Elon/hydroquinone ratio, and of the other variables. This contradicts the widely held view, that the shape of the toe can be influenced by changing the Elon/hydroquinone ratio.

Fog

The figures for fog levels will not be presented in this paper. They will appear in detail in the complete data to be published elsewhere. It will be sufficient to state, that in most cases, the fog was not extreme at the critical gamma.

Oxidation by Silver Bromide

Since both Elon and hydroquinone are concerned in the reduction of silver bromide and need to be maintained at working concentration by replenishment, it is of great interest to know the influence of the composition of the developer on their relative rates of consumption.

The ranges of developers referred to in the sensitometric work above were also tested to find the relative rates of exhaustion of Elon and hydroquinone as each developer was progressively oxidised, using motion picture positive film. The experimental method used was as follows: 100 ml. of the developer under test was run into a stoppered measuring cylinder and a weighed amount of perforation hole punchings obtained in the perforating of motion picture positive film was run into the cylinder and was allowed to develop for 10 minutes at 20° C. Suitable precautions were taken to maintain an atmosphere of nitrogen above the developer at all stages and to maintain the temperatures and degree of agitation constant. After the perforation punchings had been developed for 10 minutes, the developer was analysed to find the concentration of Elon and hydroquinone remaining and the amount of silver formed in the development was also determined.

In this way it was possible to draw curves relating the consumption of Elon and hydroquinone to the quantity of silver produced by development. These detailed graphs are too numerous to give here, but they are summarised in Figs. 6 and 7, which show the quantities of Elon and hydroquinone consumed in the production of a given amount of silver. These figures may be interpreted as showing the relative initial rates of removal of Elon and hydroquinone from the developers under test.

It will be seen that in the low pH range, 8.7 to 9.0, a considerable proportion of hydroquinone is consumed together with the Elon, although at this level of pH a hydroquinone developer would be quite inert in all practical times of development. The fact that hydroquinone has been consumed may be explained by the mechanism of the development which was given above, *viz.*, some of the oxidised Elon has been reduced by the hydroquinone, so that the hydroquinone becomes used up.

Economics of Elon-Hydroquinone Ratio

This phenomenon is most interesting to the laboratory manager from an economic point of view while Elon remains more expensive than hydroquinone. It has been suggested in some quarters that since hydroquinone is inert photographically at these low pH values and since an Elon developer will give the same general characteristics as the Elon hydroquinone developer, then the hydroquinone is best omitted to avoid its becoming aerially oxidised. We now see this to be a somewhat expensive mode of procedure, because in D76, for example, whereas a certain amount of Elon would be used if it were an all Elon developer, only half this amount of Elon is used in its present form. This, it will be seen, is much more economical in view of the fact that Elon is about three times as expensive as an equivalent weight of hydroquinone.

Another fact which emerged on carrying out this work, was that a considerable quantity of developing agent is removed from the developing

solution by the film by a sort of adsorption process. The developing agent which is adsorbed and removed is lost from the point of view of doing any useful development work. This means that a tank of developer will become exhausted even when completely unexposed film is run through it.

At higher pH values, see Fig. 7, the proportion of Elon consumed greatly diminishes, and in developers containing less than 30% of the developing agent as Elon, the amount of Elon consumed in the development is almost negligible and the hydroquinone bears almost all the whole brunt of the oxidation.

The relative rates of consumption of Elon and hydroquinone are not affected by a change in the sulphite and bromide concentrations.

VI. DISCUSSION AND NOTES ON ANALYTICAL PROCEDURES

Let us now recapitulate some of the salient points from the preceding matter. We will discuss also some points on the methods of analysis.

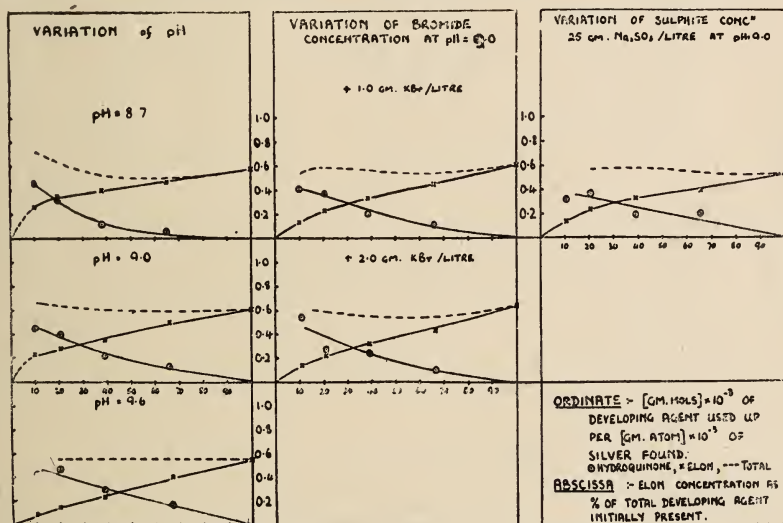


Fig. 6. Relationship between developing agent consumption and initial concentration.

The Elon-hydroquinone developer is typically composed of :

Elon
Hydroquinone
Sulphite
Alkali (as pH)
Bromide

Iodide is deliberately omitted from this list in spite of the fact that in recent years, there have been claims⁴ that the equilibrium concentration of iodide is sufficiently large to be significant in used motion picture negative and positive baths. The author's own findings⁵, however, indicate that the concentration of iodide in normal baths is negligible.

Elon and Hydroquinone

In general terms, and especially at pH levels above 9.6, an increase in the proportion of Elon leads to increased inertia speed without having any influence on the shape of the toe of the curve. In the absence of bromide at pH 9.0, there is an optimum ratio of Elon, corresponding roughly to that

found in D76, at which the inertia speed reaches a maximum, and a considerable increase in Elon proportion beyond this leads to a decrease in speed.

At all levels of pH the Elon proportion is critical when lower than 10%, its influence being most marked on the rate of development. Fortunately, in the case of positive developers of the D16 type, where the Elon concentration is small, the position is relieved to a considerable extent by the fact that the relative consumption of Elon on silver bromide exhaustion is negligible, and so its concentration does not change much. However, care must be exercised in compounding the developer and replenisher so that the correct amount of Elon is used.

Evans, Hanson and Glasoe⁶ quote tolerances for the deviation of the concentrations of Elon and hydroquinone in a negative and a positive bath. Their figures are shown in the tables.

NEGATIVE FILM IN NEGATIVE DEVELOPER

Variable	Approx. value in Aged Developer	Per cent. Error Tolerable
Elon	1.5	6
Hydroquinone...	4.0	50
KBr	1.0	4-5
pH	8.4	$\pm 0.02 pH$ unit

POSITIVE FILM IN POSITIVE DEVELOPER

Elon	1.0	10
Hydroquinone	3.0	10
KBr	1.0	10
pH	10.00	$\pm 0.05 pH$ unit

Four things should be noted in connection with these figures. Firstly, the tolerances for Elon are valid only for the proportion shown and should not be taken as holding for any Elon proportion. Secondly, even if a variation of 50% in the hydroquinone concentration in the low pH negative developer does not affect the photographic results (although the present findings do not quite confirm this) such a change would have an influence on the relative consumption of Elon and hydroquinone and on the cost of running the bath. Thirdly, the pH tolerance for the negative bath is lower than that for the positive. Fourthly, the tolerance permissible in the analytical procedure should be about half these figures, so that a tendency of the bath to deviate can be noted and dealt with before the photographic performance is affected.

Reproducibility of Analytical Results

It might be helpful to those laboratory controllers who are newcomers to the field of chemical analysis to include here a word of warning about the danger of being misled by analytical results, especially those for Elon and hydroquinone. The results of a chemical analysis are accurate and reproducible only *within certain limits*. The limits are set, first, by the method used and, second, by the skill of the operator.

An error in the absolute accuracy of a method of analysis can be overcome by incorporating a numerical factor when working out the results, and this

is usually done by the author of a particular method. However, inaccuracy due to poor reproducibility cannot be dealt with in this way, and the likely error from this source must always be remembered when considering the results. For example, if a developer containing 5.00 grams per litre of hydroquinone is analysed using a method having a reproducibility of 5%, two consecutive results could be 4.87 and 5.13 grams per litre, although the concentration in the bath had not changed.

There are a number of methods of analysis for Elon and hydroquinone. In general, some accuracy has to be sacrificed in order to achieve speed of working. Evans, Hanson, and Glasoe⁶ claim an accuracy for Elon and hydroquinone of better than 5%. Baumbach⁷ claims 2% for his iodimetric method, and Shaner and Sparks⁸ indicate an accuracy of just better than 5% for hydroquinone and Elon as determined by Baumbach's more recent method⁹ in which Elon is determined by acid titration. The potentiometric

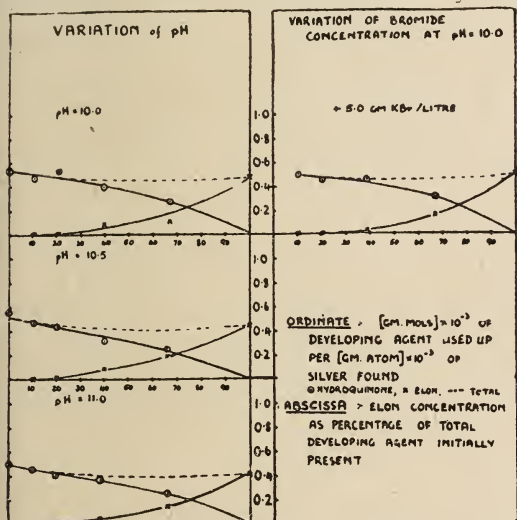


Fig. 7. Relationship between developing agent, consumption, and initial concentration.

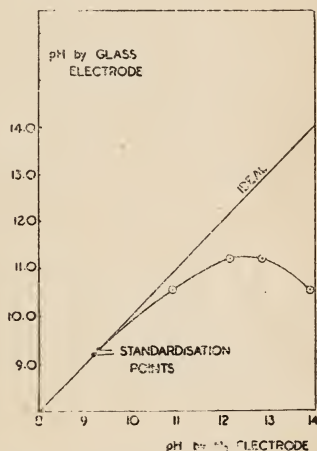


Fig. 8. The pH response of an ordinary glass electrode in the presence of 1N sodium ion concentration.

method of Stott¹⁰ is prone to give large errors, especially for Elon, which can be 14% in error. In the present author's modification of Stott's method¹¹, the errors are reduced to 1% for hydroquinone and 2% for Elon.

The most rapid methods of analysis are those in which the concentration of one component is found by subtracting the titre of the other component from the total titre of the two. This is not a good method when the Elon concentration is found by subtracting the hydroquinone value from the sum for Elon and hydroquinone, as in the Atkinson and Shaner method¹². In D16, for example, the equivalent concentration of Elon is less than 5% of that of the hydroquinone. The error in the hydroquinone determination is of the same order of magnitude. Baumbach's later method is better in this respect because the Elon is determined directly and it is the hydroquinone that is estimated by difference.

Sulphite

The concentration of sulphite is not critical and may vary by as much as 10%. A considerable reduction in the quantity used in the D76 type developer leads to a loss of solvent action and a loss in inertia speed.

The iodimetric determination of sulphite is perfectly straightforward and is sufficiently accurate for control purposes.

Alkali

The pH value is critical in that it determines the general level of activity of a developer and the direction in which a change in the Elon/hydroquinone ratio will affect the photographic characteristics. Developers in the range 8.5 to 9.5 need careful pH control because they are usually rather poorly buffered, and their pH value is easily changed. Positive developers containing the usual concentration of sodium carbonate at pH 10.0 are fairly well buffered and do not readily change in pH . Again, above a pH of 10.0 a given change in the pH does not have such a marked influence on the general characteristics of the Elon-hydroquinone developer.

The determination of accurate pH values in alkaline solutions of high sodium ion concentration which contain reducing agents is very difficult. The glass electrode is fortunately not affected by the presence of reducing agents and gives a useful response over the pH range up to 11.0. The response of the glass electrode is markedly affected by a concentration of sodium ions. Two types of glass electrode are available, which may be referred to in general terms as the "ordinary" and the "high- pH " types. The "high- pH " types are relatively insensitive to sodium ion concentrations and can give a linear pH response up to pH 12, which is ample for processing control. However, they are not recommended because, owing to the very high resistance of the glass used, the "high- pH " glass electrodes cause instability in the meter which becomes sensitive to stray electromagnetic fields, moreover, the "high- pH " glass electrode is slow in reaching a stable E.M.F.

On the other hand, the ordinary type of glass electrode has been found to give very stable and reproducible results, and it takes up its stable E.M.F. almost immediately. Fig. 8 shows how the sodium ion error affects the response of one such electrode as the pH , as measured by a hydrogen electrode, increases. This curve shows that the ordinary glass electrode may be used up to a nominal pH of 11.0 which corresponds to an actual pH of 11.75.

Buffer Solution

Control workers do not require absolute accuracy as much as reproducibility in pH measurement. However, workers in this field would understand each other better if pH values were determined in some common manner with the best practicable approximation to the absolute value. With any glass electrode there will be an error if the normality of the buffer is different from that of the solution under test.

Buffers of approximately decinormal strength are common in the laboratories although the developers contain salts to at least ten times this concentration. At Kodak Research Laboratories, a more concentrated buffer has been worked out that corresponds much more closely to practical developers. The formula is:

Sodium carbonate (anhyd.)	...	5.00g.
Sodium bicarbonate	...	5.00g.
Sodium chloride	...	58.5g.
Water	... ..	to 1 litre
pH	... ..	9.30

This buffer is easily made up and if pure chemicals are used the pH comes very close to 9.30 as measured by the hydrogen electrode. This buffer keeps very well for months. A silver-silver chloride-N/10 potassium chloride reference electrode should be used. A saturated calomel electrode will give rise to a large error. A silver chloride electrode is readily obtainable. It is much cleaner in use than a calomel electrode.

Carbonates and Borates

No reference will be made to methods of analysis for carbonates, borates, etc., because such analyses are superfluous for developer control purposes. If the concentrations of these ions in the initial bath and replenisher are known, then one will know as closely as matters what the concentration is in the bath.

Bromide

The concentration of bromide has a considerable effect on the bath. In the negative developers it causes a marked loss in speed at all Elon/hydroquinone ratios, and for maximum emulsion speed, such baths must be operated under conditions where the bromide ion concentration can be kept as low as possible. This can be achieved only by rejecting the bath at frequent intervals or by replenishment at a high rate. Both these methods are expensive unless the discarded bath or the bleed from the rapidly replenished bath is converted into positive bath replenisher. In the positive developer range a concentration of bromide of about 1.0 gram per litre is essential to restrain fog and to allow the working gamma to be reached.

The determination of bromide need only be carried out to the nearest 0.1 gram per litre and any of the standard methods will serve. The author employs a potentiometric titration using a silver electrode and silver nitrate.

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DISCUSSION

Mr. R. H. CRICKS: Under what conditions were Dr. Levenson's tests carried out? What quantity of film was used in the various tests?

THE AUTHOR: The sensitometric tests were made in a rectangular vertical tank, inside which flanges were placed so that six strips could be held, vertically, facing each other. A rectangular paddle which fitted snugly in between the six strips was driven up and down. The tank was designed to keep the area exposed to the air as small as possible—it was fitted with a lid to restrict the access of air, and provision was made for covering the developer with an inert atmosphere, but this was not found necessary. The degree of

agitation approximated to that found in best laboratory practice.

Mr. W. M. HARCOURT: Have you discovered in your experiments with high agitation, that you can arrive at a point where with an increase of agitation, you suddenly begin to lose film speed?

THE AUTHOR: It is conceivable that although the agitation of the main body of the developer is steadily increased, the effective wiping at the emulsion surface can pass through an optimum and then decrease. It all depends upon the design of the machine.

Mr. R. HARDING: What property in a developer has the maximum effect on the toe characteristics?

THE AUTHOR: For a given material, and for a given gamma, you can develop in a wide range of Elon-hydroquinone developers without significantly altering the toe shape. Increasing the bromide, for example, has no significant effect; changing from an Elon-hydroquinone developer to an all-hydroquinone developer has no significant effect; pH will influence the rate at which a given gamma is obtained. But once you get to a given gamma, then the shape of the toe is the same with any Elon-hydroquinone developer.

MR. W. M. HARCOURT: Have you found the peculiar phenomenon that you can mix a developer very carefully to a given Elon-hydroquinone balance—you immediately make a chemical analysis and find that the analysis gives different results from your mix?

THE AUTHOR: There are two causes of that deviation. One comprises the errors in the analysis; you must be very guarded about analytical results. Unless you take pains to control the sources of errors you must not expect an accuracy of better than 5%. Secondly, we found that the best way to mix a developer without loss of developing agent through oxidation, was to take a conical flask of distilled water, and bubble in nitrogen. It swept the oxygen out of the water, above which it formed an inert atmosphere. The chemicals were poured in a fine stream through the nitrogen layer and solution was assisted by the agitation induced by the bubbling gas.

MR. W. M. HARCOURT: I assume that the thing to do, having made your initial mix and then made a chemical analysis, is to keep that chemical analysis from then on? You would not try to balance the bath to what it should be?

THE AUTHOR: There is no real point in it, unless the discrepancies are very large, because you are faced with the probability of error in your analysis. Unless you are prepared to investigate that at length, you should see that your developer is made up with great care, and if the deviation is less than 5%, you should accept the bath as mixed. Only if you are getting a definite trend in the wrong direction should you try to counter it.

MR. C. F. PARKINS: May not the question of chemical purity come into this matter?

THE AUTHOR: The commercial brands of metol in general, and of hydroquinone,

if they look white and clean, are usually very pure—over 99%. Sulphite may contain small amounts of carbonate, which can influence the pH of a D76 bath. The formula for D76 does not specify the pH ; unless you specify the pH you have a bath which may be just as different from D76 as if you put in an extra grain of borax or took it away.

MR. C. F. PARKINS: You raised the question of the pH of a D76 developer. Could you expound a little on the buffered borax developer?

THE AUTHOR: The buffered type of developer, such as D76d, contains about 8 grams of borax and .8 grams of boric acid per litre, whereas D76 contains 2 grams of borax, which activates it sufficiently to do the job for which it is intended. But this quantity of borax has only slight buffering power. Buffering the developer is very expensive in boric acid and borax, because you usually find you have to put in a large amount, and if the aerial oxidation is high compared with the bromide oxidation, you may even find that you have to use a relatively acid replenisher to keep the pH down. You can keep the pH down with strong acid added very cautiously. If the bath does show a steep rise in pH , it is best to check the pumps to make sure the glands are not admitting air.

MR. R. HARDING: You have not mentioned the effect of developer oxidation products in a developer.

THE AUTHOR: The effect is negligible on the sensitometric properties. When you have run a bath for a good while, you have present a considerable concentration of sulphonates, but their effect is less than 10% of that of unoxidised developing agents.

MR. R. HARDING: They tend to give staining if you have a high concentration.

THE AUTHOR: If you run a strongly alkaline bath for a long time, reddish-brown humic acids are formed, which will stain.

MR. T. WHITE: You did say, that with zero proportion of hydroquinone in the D76 bath, you would get a high emulsion speed. Would not that in turn tend to bring up the fog level?

THE AUTHOR: Not much when working at gamma .65. Moreover, a small increase in the fog on a negative is not harmful, provided it is uniform.

PROBLEMS OF THE 16mm. PROCESSING LABORATORY

D. F. Cantlay, M.B.K.S.*

Read to the B.K.S. Sub-Standard Film Division on January 29, 1947

THE war proved the value of 16mm. as an ideal training medium, and all three services demanded of the laboratories a very greatly increased output. Consequently, all available plant had to be converted to the mass production of positive prints by the reduction method, and production on original 16mm. negative or reversal had to be temporarily abandoned.

The enormous demand for release prints, always required in a hurry, led to the utilisation of every possible means of obtaining prints of reasonable quality. However, since the end of the war, the laboratories have been called upon to deal with a great deal more production directly on 16mm. film, and in an attempt to obtain the perfect sound print, a number of new methods have been worked out.

Alternative Methods of Producing 16mm. Prints

The position today is that 16mm. prints can be made in a bewildering number of ways. Fig. 1 shows the picture processes only. On the left-hand side, the direct 16mm. methods are shown, on the right, the methods using a 35mm. original.

The reversal method uses the original camera film for projection, the negative image normally obtained being reversed in the processing. This processing is normally carried out by the stock-manufacturers, and it is not proposed to consider it further here.

Reversal copies can be made by printing from the original, and again reversing, or by making a duplicate negative, and making prints in the usual way.

The second method is the direct negative-positive system, in which the positive print is made on a contact printer. A complication which arises at this point is that, should sound be required, optical left to right reversal of the image must be employed, since projectors are normally set to comply with standards suitable for 16mm. sound prints from 35mm. originals, that is, emulsion to the lens. A print from a negative is projected emulsion to the lamp. The optical reversal brings the emulsion of the print to the lens, and the track into sharp focus. This is most necessary for the higher frequencies on 16mm. film.

A soft duping print can be made from an original negative, and from this, duplicate negatives are obtainable for release printing. A particular application of this process will be mentioned later.

Prints are made from 35mm. originals on a reduction printer, by several methods. The original negative or a duplicate negative will print a 16mm. positive. A soft duping print may be made of the 35mm. original, and reduced to a 16mm. duplicate negative, from which prints can be made by contact printing. A soft duping print on 16mm. may be made from an original or a duplicate negative, and a 16mm. duplicate negative made by contact printing, final prints being taken from this 16mm. negative also by contact printing.

The Sound Track

Any of these methods may require sound, and Fig. 2 shows the various

*Sydney Wake, Ltd.

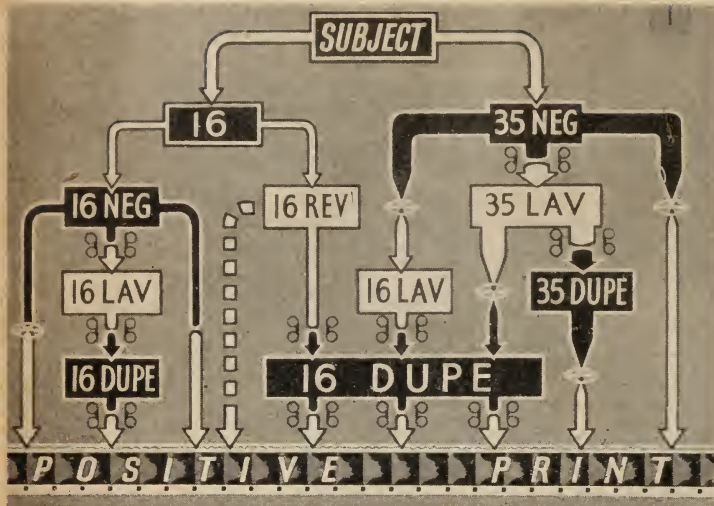


Fig. 1. Methods of producing the Picture on 16mm. Film.

Another method introduces re-recording from 35mm. positive. This has the advantage of making it possible to introduce frequency correction, in order to compensate for loss of higher frequencies, due to the low linear speed of 16mm. running. It is also desirable to cut off frequencies above 6,000 cycles per second, in order to minimise cross-modulation troubles. In some cases, 35mm. film is re-recorded on to 35mm. in order to obtain a frequency-corrected negative, from which optically reduced prints are made. From a positive print of a frequency-corrected negative, an optically reduced 16mm. negative could be printed as described above, and contact prints of this negative would then be made.

Any of these methods may be used with any of the picture production methods already outlined, and it is obvious that unless a very careful balance has been achieved, serious difficulties will soon arise.

The Requirements of Processing

Modern high-speed-developing machines handling release prints can only be run economically if the balancing of the different processes has been done at the various printing and negative stages, since, unlike still photography, with its various grades of paper, cinematography has only one final positive material. It is, therefore, important to consider the possibilities and requirements of the final prints, and adjust the preliminary processes accordingly.

The requirements of a print are that it should reproduce on the screen a faithful rendering of the original subject in tone values. The determining factor of the quality of a print is therefore its contrast, the measurement of which is made by means of sensitometry. The curve (Fig. 3) is steep—that is, the gamma is high.

This print must have been made from a negative, and Fig. 4 shows a typical negative curve from which such a positive might have been printed.

Negative and Positive Gamma

Comparison of Figs. 3 and 4 will show the essential difference between the positive and negative gammas. On the positive curve, any difference of exposure, as plotted on the exposure axis, is increased by the gamma (2.5) if plotted against the density axis, owing to the angle of the straight line section. The tangent of this angle is gamma.

means now employed. The original sound source, either through a microphone or off a disc or other recording, can be recorded directly on to the final print, if only a single copy is required. Alternatively, a 16mm. duplicate negative may be made, and the prints taken by contact printing. From a 35mm. original negative, the sound may be reduced optically on to a 16mm. print, or, from a 35mm. print, a 16mm. negative may be made optically, and subsequent prints made by contact printing.

RECORDING HEAD

RECORDING HEAD (F C)

16 NEG

35 NEG

35 POS

35 TO 16 (F C)

16 NEG

35 TO 35 (F C)

35 NEG

35 POS

16 NEG

16 M.M. SOUND PRINT

It will be noticed, however, that the combined gamma of negative and print in the example shown equals 1.5, that is, greater than unity. This is deliberate, and is done in order to overcome the loss of contrast that will inevitably occur through light scatter in lenses and in the projection theatre.

Three Differences in Contrast between Highlight and Shadow

In order to obtain a positive image capable of projection, the question of the correct exposure in printing of that emulsion makes grading arrangements very necessary. The ideal printing light would place the tones on the positive emulsion well into the over-exposed range, although the differences in negative contrast are quite normal. It is therefore necessary to reduce the printing light by the requisite number of printer points (a printer point is .05 of negative density) to bring the positive within the projection range.

The fullest possible application of control of contrast is found in the process of producing a print by means of a duplicate negative. It may be that in a particular case, the original negative is too hard, *i.e.*, the range of contrast is too great to compress within the positive emulsion range unless the positive gamma is considerably reduced. This can be done by varying the positive

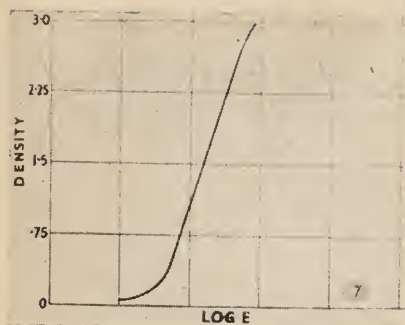


Fig. 3. A typical Positive Curve.

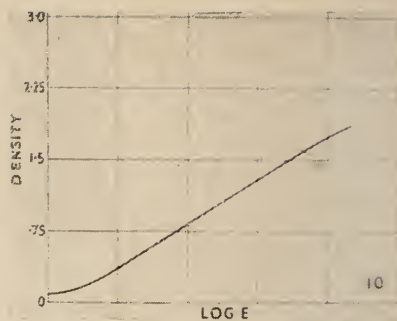


Fig. 4. A typical Negative Curve.

developing time, but if it is, certain troubles immediately arise : (a) No standard of grading can be maintained ; (b) Inconsistent results are obtained ; (c) Developing is delayed whilst adjustments for a particular job are made, during which time a large number of other reels are held up ; (d) Variable

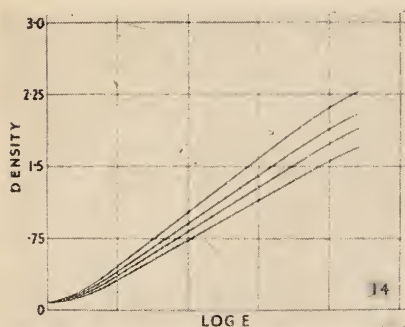


Fig. 5. Control of Negative Gamma by variation of Processing Time.

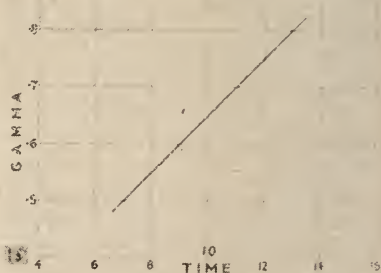


Fig. 6. A typical Time-Gamma Curve.

area sound track must be of a high contrast for best results, and must be absolutely consistent.

It is for these reasons that every endeavour is made to have a fixed positive developing time and a fixed positive contrast. The negatives should, therefore, be made to suit the positive conditions. Correction can be applied in duping by application of the time-gamma curves for the duping emulsions.

Yet another variable factor that must be kept in mind is the difference in overall gamma likely to result between a contact print from a 16mm. negative and an optical print from a 35mm. negative, as the contrast in optical printing is much greater than in contact printing.

DISCUSSION

Mr. W. BUCKSTONE : Would it be worth while considering in making the picture, photographing in a high key ?

THE AUTHOR : Yes, I think it would be better. We can get our tone range in a high key, still retaining the intensities in the lower scale. Another way of getting a light print with soft gradation is by getting a low positive gamma. The difficulty is that sound requires a high positive contrast.

Mr. H. E. DANCE : In schools there are two reasons why light prints are demanded. Firstly, the schools have not much money. Secondly, the projector must be portable.

Mr. W. BUCKSTONE : Have you an optical bench available for 16mm. yet ?

THE AUTHOR : We have one under construction, but it is taking a little longer than we had anticipated. We also have under construction a direct wipe machine.

DEVELOPMENTS IN SOUND TECHNIQUE AND EQUIPMENT

B. C. Sewell, M.B.K.S.*

Summary of paper delivered to a joint meeting of the British Kinematograph Society and the Association of Cine-technicians on January 22, 1947. The paper has been more fully reported in The Cine-Technician, March/April and May/June, 1947.

MR. SEWELL commenced his paper by outlining the physical properties of sound waves, and discussing the principles of acoustics and reverberation. Definitions of the decibel and the phon led to an explanation of the need for equalisation, and the methods adopted to secure it.

The next point considered was the design of microphones. The directional properties of the moving coil, ribbon, and cardioid types were contrasted; the particular field of application of the directional types, in excluding extraneous sounds and modifying apparent reverberation, was stressed.

Mr. Sewell next turned to the requirements of volume range in film recording. The causes of background noise were discussed, a point mentioned being that in variable density recording a low but appreciable density produced a maximum background noise. This led to an explanation of the principles of noiseless recording and the advantages of fine grain emulsions. Distortions inherent in variable density and variable area recordings were outlined.

Arising out of the rectification effect, the speaker gave an explanation of the benefits of push-pull recording, differentiating between Class "A" and Class B. Flutter was defined, and the method of measurement explained; a flutter meter consisted of a selective amplifier tuned to the frequency of the test tone employed, followed by a limiter and discriminator. A meter indicated the departure of the frequency from the discriminator mean. A cathode-ray oscilloscope might also be employed to indicate the waveform of the flutter.

Mr. Sewell briefly discussed disc and magnetic recording; he suggested that for the latter to be applied to film work, means of synchronisation could be devised, although there would at present remain the serious disadvantage of the invisibility of the record.

A primary object in the recording of speech, said the speaker, must be intelligibility. Removal of the lower frequency components had little effect upon intelligibility, but of high frequency components, the reverse was true. The reverberation characteristics of cinemas frequently caused a bass component to be augmented and prolonged. Consequently, it was often felt desirable to give dialogue recordings a low bass constant. Electronic compression might assist in maintaining intelligibility; by far the greater part of the energy in speech lay in the region below 1000 c.p.s., and it was sometimes an advantage to employ pre- and de-emphasis of high frequencies in studio processes, although this might introduce distortion of sibilants.

Finally, the speaker referred to acoustic perspective, and concluded by discussing the possibilities of stereophonic recording. It was possible by the use of two or more microphones, recording and reproducing channels, and loudspeakers, to simulate normal hearing so that lateral discrimination was restored. Twin stereophonic tracks had been recorded on the German Magnetophone.

* Gainsborough Pictures, Ltd.

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DISCUSSION

Mr. N. LEEVERS : Recently there has been a tendency to use penumbra recording, which produces the same type of density track as the light valve. Has Mr. Sewell any information of the relative results so far as fidelity and general efficiency are concerned?

The AUTHOR : As I understand it, the penumbra characteristic can be made non-linear in any desired manner, in order to compensate for non-linearity of the photographic characteristic.

Mr. T. S. LYNDON-HAYNES : Mr. Sewell said that he would like to use perspective to get a certain off-stage quality when a line was spoken off-screen. Most editors when they are cutting generally use the track that was recorded when the person speaking was actually photographed. Does Mr. Sewell think it worth getting an off-stage quality?

THE AUTHOR : Yes, I do think it worth while, and we usually get tracks of that nature to cover such scenes. If the editor uses the wrong track we get it altered.

Mr. COLE : I understand that in the Western Electric system compression is used purely as a limiter, whereas in the RCA system it depends to a considerable

extent upon individual preference. Could Mr. Sewell tell us whether it is advisable to set up a particular ratio and hold it throughout the production, irrespective of background and set, or is it advisable to change the ratio to suit the particular set? Also, is it advisable to use compression again in re-recording?

THE AUTHOR : I think it probably is desirable in some cases to alter the ratio. With a noisy set, you get an excessive background, with the use of compression on the other hand, if you want to get compression you get that effect anyway. If you can be sure that you have got the right amount of compression, it is better in the original channel; on the other hand, it might not be enough, and you can add a bit in the re-recording channel. Some types of dialogue may require less compression than others—particularly dialogue which is not declamatory, and low speech.

Mr. GIBSON : Are there any serious difficulties caused by film base halation at high frequencies?

THE AUTHOR : There used to be such difficulties, but with the excellent stocks now provided, such difficulties have become almost unobservable.

PROJECTION PROBLEMS

Discussion between members of the B.K.S. Theatre Division on April 20th, 1947.

Why does a condenser arc appear to give a better definition than a reflector arc?

Mr. R. PULMAN : It seems that the questioner really means quality of screen illumination rather than sharpness of focus. Dealing first with the spectral composition of the light, the collection angle of the reflector arc is in the neighbourhood of 140° , which suggests that the reflector must receive some light emission from the incandescent shell of the positive carbon, therefore inclining towards the red end of the spectrum. The collection angle of the condenser arc is only about 75° , the light therefore inclining towards the blue end of the spectrum.

Consideration of the polar curves of the carbons and of the geometric forms of overlapping and enlarged images of the crater, suggests that the reflector type of arc can be expected to give a much flatter distribution across the screen. A fall-off at the sides might be preferable.

It should not be forgotten that the quality and type of all materials which transmit or reflect light of the various wavelengths leaving the carbon crater can appreciably alter the spectral composition of the resultant emission incident upon the observer's eye.

Dr. F. S. HAWKINS : Another factor in the matter might be the greater gate heat of the mirror arc, due to which the film would presumably buckle more in the gate, so reducing definition. I recall a paper by Kodak in

which methods are described of filming the buckle occurring during the time that the film is stationary in the gate.

It has been stated that 50% of light is lost at the gate of the projector, and that the screen distributes 80% of the light in directions in which there are no patrons; what steps can be taken to reduce these losses?

Mr. R. H. CRICKS : The question emanated from me. These two points represent the most serious losses between the rectifier and the patron's eyes. If they can be obviated, either current can be saved, or the picture made brighter.

Mr. R. PULMAN : The efficiency of the screen might be much improved upon by the adoption of the lenticular principle.

Mr. A. KINGSMILL : Does not the rear shutter involve greater loss than the front shutter?

Mr. R. PULMAN : To a slight extent this is so, but the loss is well justified by the reduction of gate heat.

Mr. S. T. PERRY : I attribute the introduction of the rear shutter to the use of the 6in. condensers for the Hall and Connolly arc, and the 14in. mirror of the Magnarc.

Mr. R. H. CRICKS : On the contrary, twenty-five years ago, a certain exhibitor was dissatisfied with the high gate heat produced by his 5½in. mirror arcs; he extended the shutter shafts of his Pathé projectors and fitted a second shutter—the predecessor of the modern twin shutter.

What precautions are taken in earthing sound systems in kinemas, and why?

Mr. W. F. GARLING : Precautions are taken in earthing sound systems mainly for three reasons: namely, safety, prevention of extraneous noise from the speaker system, and to provide stability of the amplifier system.

When installing sound equipment, it is essential that screwed steel conduit be used to ensure good electrical continuity. The sound-heads, amplifier racks, and any other cabinets containing equipment should be connected to a common earth by means of separate conductors, which should have a current carrying capacity of not less than the largest size of cable used in the installation, usually 3/.036.

In what way does a deteriorated or resurfaced screen impair sound reproduction and picture quality?

Mr. F. H. SHERIDAN-SHAW : Every time a screen is re-surfaced, the perforations become more clogged, eventually leading to a loss, particularly in the high frequencies, of twenty per cent. each time. There will be no deterioration in picture brightness. Generally speaking, the deterioration of a screen depends upon the atmospheric conditions in the theatre, where the theatre is situated, whether it has a plenum plant, and whether it has tabs. Cleanliness behind the screen cannot be over-emphasised.

In what manner can the presentation of lantern slides be improved?

Mr. S. T. PERRY : The lantern slide is woefully out of date. Most of them show a tendency to vibration; the arc lamp should be H.I., to maintain the colour of light when changing over from film; the lens should be of shorter focus to enable the slide to fill the screen, and most important of all, the slide carrier should accommodate the American oblong slides, and the condenser should be of 5in. diameter to cover them. Many slides are too dark. Bi-unial lanterns would be an advantage, permitting the change from one slide to another to be by iris diaphragm.

THE TASK OF THE FILM DIRECTOR

Maurice Elvey

Summary of a Paper read to a joint meeting of the British Kinematograph Society and the Association of Cine-Technicians, on February 19th, 1947.

THE work of the film director can be likened to that of the conductor of a symphony orchestra. Some other person has composed the music, and other people are going to play it. The conductor's task is to see that all the component parts of the orchestra are welded into a whole—the film star might almost be likened to the soloist with the symphony orchestra.

When a man starts to conduct a recognised piece of music, such as a Beethoven symphony, he will conform to the notes set down. There is an immense difference between the work of a good conductor and a hack conductor. Without the guiding hand of a good conductor, the music becomes merely a routine affair.

Equally, there are two types of film directors ; some such as Carol Reed, and René Clair, are entirely original in their work, and will mould the film to their conception of what it should be. The analogy of the hack conductor is the film director who merely works under instructions, and has not the initiative, the drive, the will-power of the first type of director ; but even so, he may turn out a competent work.

The Director's Responsibility

A director must know the technicalities of production ; a man who aims to be a director must start in a routine job. In my early days, the director was not only the man who directed the actors, but he cared for the business side, he wrote the script, and cut the film. The cameraman would often have to develop his own negative, and the negative itself was cut, joined up and projected, to save the expense of a print. The director must know, by practical experience, every side of the business, just as the conductor knows the range and possibilities of every instrument in his orchestra.

The producer and the director both have a great responsibility to the public. Films must never descend to obscenity, or give offence to decency. I have never pandered to the lower side of human nature—for instance, I have always attempted to avoid scenes that involve brutal fights.

As to propaganda—I recall a remark that Ernest Bevin made : “ I don't ask you to put any propaganda in pictures,” he said—“ there is no place for propaganda in entertainment ; I ask you, if you can, to show that the judiciary is, and always must be, superior to the legislature.”

During production, the role of the director is more than a guiding spirit to the actors in their performance. He has to maintain the spirit of the story—to help the artistes to maintain continuity of mood. He has to secure the co-operation of the technicians ; he must make everybody, stars and technicians, feel that they *want* to make that particular film—that their particular job is of the utmost importance. The director must decide numerous technical matters ; whether the film shall be photographed in high or low key, whether the sound shall be loud or quiet.

Production Requirements

Production could be speeded up if instead of a large number of lamps, fewer and larger sources could be used. The cost of exterior scenes must be cut ; the present trend of working in the studio, because it is cheaper, must be sacrificed in favour of the greater realism of true exteriors.

The personal comfort of the location crew must be looked after—on my two forthcoming films, for example, a mobile canteen is being provided close up to the cameras. It is necessary for the crew to be prepared to start work immediately on call; the sun may shine for only six minutes, and in that time, they may have to get in five minutes' shooting.

Director, Editor and Producer

The editor must be constantly with the director from the beginning, from the planning of the film; he must get into the director's mind and know the kind of film the director wants. In the editing he must assemble the film as the director has tried to shoot it.

The prime duty of the director is to take responsibility; his must be the last word on the editing; his must be the decision as to the suitability of the music. Only in the case of a clash should the matter be referred to the producer. A good producer can inspire the director, but he should not interfere during production.

The best way of settling a diversity of opinion, is by means of a sneak preview. Even though the audience may give no visible reaction, one can feel in a second their feelings.

DISCUSSION

Mr. B. DAVIDSON: To what extent do you think pre-planning can be carried? Do you think that realistic sets are necessary for good acting?

THE AUTHOR: A great deal of pre-planning of lighting could be done; if the mood of the picture has been decided upon, the general lighting of almost any shot must be similar. My experience has been that actors are not really affected by the background.

Mr. T. S. LYNDON-HAYNES: Can Mr. Elvey tell us why working is slower than before the war?

THE AUTHOR: If I could answer that question, I would be a very clever man.

Mr. R. H. CRICKS: Does Mr. Elvey think low-key lighting is essential for artistry? It may be popular in the West End, but in a cinema with 2 foot-candles on the screen, it is very unpopular.

THE AUTHOR: Yes, certain subjects could be photographed in no other key.

Mr. C. WHEELER: I am glad the question of speed of production has come up. If we go back to the pre-war period, I think you will find that there was a certain drive that carried along the tempo of shooting; that drive came from the top—from experienced directors, cameramen and so on.

CO-ORDINATION OF BRITISH AND GERMAN STANDARDS

The co-operation existing between British, American and French standardising bodies was carried a stage further, when a joint meeting, held on January 30th, of the Photographic and Kinematograph Industry Steering Committee of the British Standards Institution was attended by Dr. Frank, Director of the Deutscher Normenausschuss.

From the point of view of cinematography, the most important of the photographic subjects discussed was that of emulsion speed; it appeared that the differences between British, American and German methods of measuring and expressing speed were not important, and could no doubt be reconciled. Another matter discussed was the standardisation of lantern slides.

In the field of cinematography, a large number of British and German standards

specifications were briefly reviewed, and arrangements were made for the reciprocal study of the specifications by the appropriate committees of the two bodies. The subjects covered fell under the following headings:

- Dimensional standards of film;
- Features of film (*e.g.*, standard leaders)
- Screen brightness;
- Projector lenses and fittings;
- Electrical equipment for cinemas and studios.

Practically the only German specification not matched by a corresponding British standard was one relating to arc carbons.

General matters discussed included the extension of the Universal Decimal Classifications for cinematography, and the desirability of a wider use of English or metric dimensions throughout the Industry.

TECHNICAL ABSTRACTS

Most of the periodicals here abstracted may be seen in the Society's Library

STUDY OF THE SPECTRAL SENSITIVITY OF PHOTOGRAPHIC PLATES.

André Bernanose, *Science et Industries Photographiques*, October, 1947, p. 289.

The author wished to study the distribution of energy in the spectra of very dim light sources by comparing them with the spectra obtained from a comparison lamp at various intensities, but with shorter exposure time. As a result of the experiment described, he concludes that the errors due to this procedure are less than the experimental errors for variation from 30 to 600 seconds, but may exceed the experimental errors outside this range. M. V. H.

ON THE RESOLVING POWER OF PHOTOGRAPHIC LAYERS.

Louis Falla, *Science et Industries Photographiques*, October, 1947, p. 294.

The author, after describing the conditions to be observed if measurements of resolving power are to be comparable, and his own experimental conditions, describes tests on 16 emulsions (4 precipitation rates, each with 4 Ostwald ripenings). Three emulsions were further given two periods of second ripening. He concludes, that for each duration of Ostwald ripening, there is an optimum precipitation rate for maximum resolving power and that the resolving power is independent of the duration of second ripening. M. V. H.

PRODUCTION OF THE SURGICAL TEACHING FILM.

R. G. W. Ollerenshaw, M.A., B.M., B.Ch., M.R.C.S., L.R.C.P.(Assoc.), *Photographic Journal*, Section B, July, 1947, p. 82.

The proper significance of the motion picture film in the training of the medical student and the post-graduate medical practitioner is discussed. Three particular uses of film in teaching are outlined: as a "summary" for case recording, in the demonstration of physical signs. The importance of having an essentially medical production unit is stressed, and the advantage of discussion with other units before a film is made is mentioned. Colour is considered essential for almost all films, but sound has definite disadvantages. The various stages in the production of a surgical "summary film" are then described in detail: personnel, preliminary procedure, methods for ensuring continuity, are discussed. Lighting equipment is described: suggestions for suitable lens apertures, range-checking methods and towelling are given. The final stages of production cutting and distribution after release are briefly dealt with.

LIGHT SOURCES FOR COLOUR PHOTOGRAPHY WITHOUT FILTERS.

Max Nagel, *Foto-Kino-Technik*, Sept., 1947, p. 7.

Following consideration of the colour temperature required for exposure of Agfacolor and Kodachrome films, tables show the colour temperature of a number of artificial light sources, and of natural light at different times of the day and in different months. R. H. C.

AUTOMATIC GAIN CONTROL AND LIMITING AMPLIFIER.

W. M. Jurek and J. H. Guenther, *Electronics*, Sept., 1947, p. 94.

The peak-limiting amplifier as used for sound recording and radio broadcasting purposes operates effectively when the average programme level presented to it lies near to a predetermined optimum value. In the design described, the limiting amplifier is preceded by an automatic gain control stage, termed the "Guardian," which is peak operated and includes a delayed recovery circuit. This ensures that linear amplification is maintained over the body of the signal. The recovery time may be adjusted from 2 to 8 seconds, according to the nature of the programme material. N. L.

STEREOSCOPIC FILM.

J. McLeod, *Sight and Sound*, Autumn, 1947, p. 118.

A subjective description of the Russian stereoscopic kinema in Moscow, and of the full length film made by the process, "Robinson Crusoe," suggests that a high degree of stereoscopic illusion is attained. The patron must, however, keep his head stationary if the illusion is to be maintained. R. H. C.

THE COUNCIL

Meeting of January 7th, 1948.

Present : Messrs. I. D. Wratten (*President*), W. M. Harcourt (*Vice-President*), E. Oram (*Hon. Secretary*), P. H. Bastie (*Hon. Treasurer*), C. Cabriol, R. B. Hartley, B. Honri, L. Knopp, A. W. Watkins, A. G. D. West (*Past President*), H. S. Hind (*representing Sub-Standard Division*), G. Burgess (*representing Film Production Division*), R. H. Cricks (*Secretary*).

Co-operation with other bodies.—Further progress in co-operation with the S.M.P.E. and the A.S.A. was reported. The Secretary, who was visiting Paris, was authorised to arrange similar co-operation with the Association Française des Ingénieurs et Techniciens du Cinéma.

Film Mutilation Committee.—It was reported that a meeting of B.K.S., C.E.A. and K.R.S. representatives was to be called for January 26th to discuss the preparation of brochures on film mutilation.

Leeds Branch.—It was reported that a meeting was being held in Leeds, on February 9th or 10th, to discuss the formation of a branch in that city.

Proposed Canadian Branch.—Brief consideration was given to the possibility of inaugurating a Canadian Branch.

Home Office Regulations.—It was reported that a meeting was to be held shortly of the Committee appointed to consider the Draft Regulations under the Cinematograph Act.

Theatre Division.—It was reported that a meeting of the Sub-Committee on Test Films was to be held the following day.

Sub-Standard Division.—The possibility of avoiding the duplication with other Societies of meetings concerning the sub-standard film was briefly considered.

Presidential Address.—A vote of thanks to Mr. Wratten for his admirable presidential address was carried.

Standard Forms for Kinematography.—Representation of the Society on a B.S.I. Committee on Standard Forms for Kinematography was arranged.

Universal Decimal Classification.—A report was made concerning the co-ordination of the sections on kinematography in the U.D.C., which the B.S.I. was undertaking.

EXECUTIVE COMMITTEE

Meeting of January 7th, 1948

Present : Messrs. I. D. Wratten (*President*), W. M. Harcourt (*Vice-President*), E. Oram (*Hon. Secretary*), P. H. Bastie (*Hon. Treasurer*), R. H. Cricks (*Secretary*).

Elections.—The following were elected :—

JOSEPH WILLIAM BAKER (Member), Capitol Cinema, Aylesbury.

ROBERT ERIC BACK (Associate), Pathé Pictures, London.

JOHN HOWARD JACOBS, M.A. (Member), Denham Laboratories.

SIR ALEXANDER KORDA (Member), Film Producer.

LAMBERTUS JACOBUS MARIA ROSENBOOM (Member), Studio-manager, Amsterdam.

RAYMOND CECIL LANGE THORN (Associate), Pathéscope, Ltd.

WILLIAM THOMAS GIDDINGS GREEN (Associated), Warner Bros.

LOUIS J. MANNIX (Member), Regent Cinema, Leeds.

Transfers.—The following Associates were transferred to Corporate Membership :—

HENRY GRATWICKE HALSTED, Marylebone Studios, Ltd.

LIONEL KEITH ANTHONY TREGELLAS, British Movietone, Ltd.

HAROLD ARTHUR JAMES PAGE, G.F.D. Film Laboratories, Ltd.

JAMES WILSON, National Studios, Boreham Wood.

ELFRA LORRAINE PRIDEAUX, Concord Film Unit, London.

ROBERT ALFRED ALLMAN, Warner Bros. First National Productions, Ltd.

Resignations.—The following resignations were accepted with regret :—

ALISTAIR RODERICK MACKENZIE (Associate), Telephoto and Radio Engineer.

HAROLD HERBERT HOOPER (Associate), Film Producers Association.

J. A. BLENKIN (Associate), Kodak, Ltd.

GORDON A. HEYNES (Associate), Chartered Accountant.

J. F. WATTS (Associate), Warner Bros.

REGINALD V. CROW (Member), Palace Theatre, Ramsgate.

E. BOJMHOLC (Student).

T. E. EASTAFF (Associate).

Expulsion.—Membership of the following was terminated :—

L. A. FITZGERALD (Student).

M. HYMAN (Student).

F. G. L. BENSON (Associate).

Ordinary Meeting.—It was agreed that the Ordinary Meeting of the Society should be held prior to the General Meeting on April 14th, 1948.

EDUCATIONAL FOUNDATION FOR VISUAL AIDS

An organisation which will enable the use of educational films to be developed on a very large scale in schools, is to be established by the Minister of Education as soon as possible.

It will be known as the Educational Foundation for Visual Aids and its function will be to promote the preparation, distribution, maintenance and use of visual aids as a medium of education.

It is expected that nearly every school in the country will eventually be equipped with kine projectors and other visual apparatus. Educational films and much of the other material required, will be purchased by local education authorities through this new organisation.

Journal of the BRITISH KINEMATOGRAPH SOCIETY

Copies of many of the back issues of the *Journal* are available, price 5s. 3d. post free (since January, 1947, 3s. 2d.).

Proceedings of the BRITISH KINEMATOGRAPH SOCIETY

Prior to the inauguration of the *Journal*, papers read to the Society were reprinted in *B.K.S. Proceedings*. Nearly complete sets (1931 to 1936) are available price 10s., post free.

DIVISIONAL PROCEEDINGS

The following *Proceedings* of the Divisions of the Society have been published, price 5s. 3d. each post free :

Theatre Division, 1944/45.

Theatre Division, 1945/46.

Sub-standard Film Division, 1944/45.

Film Production Division, 1945/46.

THE LAW OF COPYRIGHT AND THE FILM

by A. Krestin, L.I.B.

Reprints of this valuable paper from the January issue are available.

Price 1s. 6d.

BOOK REVIEW

ANATOMY OF THE FILM, by H. H. Wollenberg. 104 pages. Marsland Publications, Ltd.

This worthy contribution to the serious literature of the screen claims in its subtitle to be "an illustrated guide to film appreciation." It is a big claim to make, but by no means unjustified, for Dr. Wollenberg has made an earnest effort to analyse the factors that make the film, as he claims it to be, one of the world's great arts : an art so potent that, as he says, "If a film is worth anything at all, the audience will always succumb to the illusion that they are watching reality caught by the camera."

To turn for a moment to the illustrations : these are first-class, and are chosen for the most part to illustrate some specific technical point discussed in the text. They are taken from pictures of all periods : from films made during fifty years of the art.

It is no serious defect of this work, which has been based on a course of Cambridge University extension lectures, that the reader will not always agree with the author. It is sufficient that the ideas advanced will be found suggestive and the serious student will find plenty of material to stimulate thought. J. C. WARBIS.

PERSONAL NEWS OF MEMBERS

H. G. MASON has left Hastings-Hodgkins, Ltd., and is now with H. & G. Enterprises, Haymarket, S.W.1.

JOHN NEW is leaving the film trade, and shortly flying to Southern Rhodesia, where he is taking up farming.

LEONARD JAMES PAUL KAMM

Died January 27, 1948

At the early age of 45, Leonard Kamm died of cerebral hæmorrhage while on a business visit to Sidmouth.

Leonard Kamm was the son of the late L. Kamm, one of the pioneers of the film industry, and was until the death of his father engaged in the business of Kamm & Co. Following a brief association with the late William Engelke, of Cinema Traders, Ltd., he founded in 1931 the firm of Cinetra, Ltd. P. H. B.



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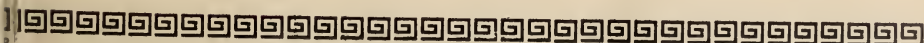
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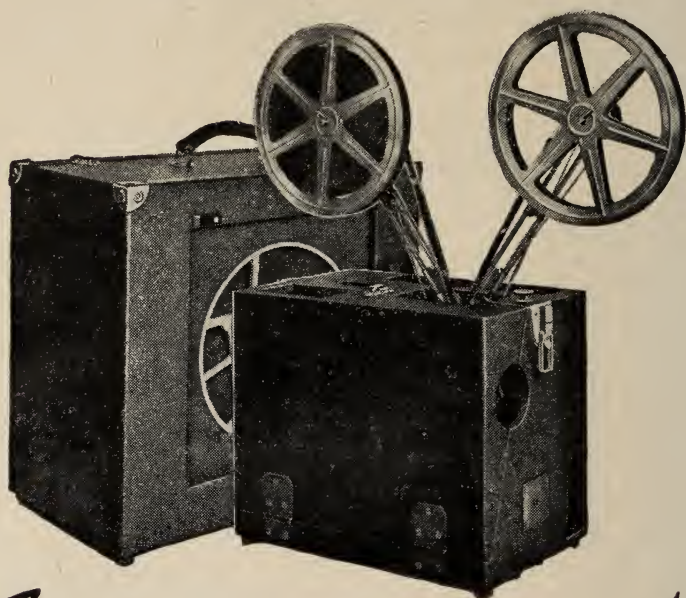
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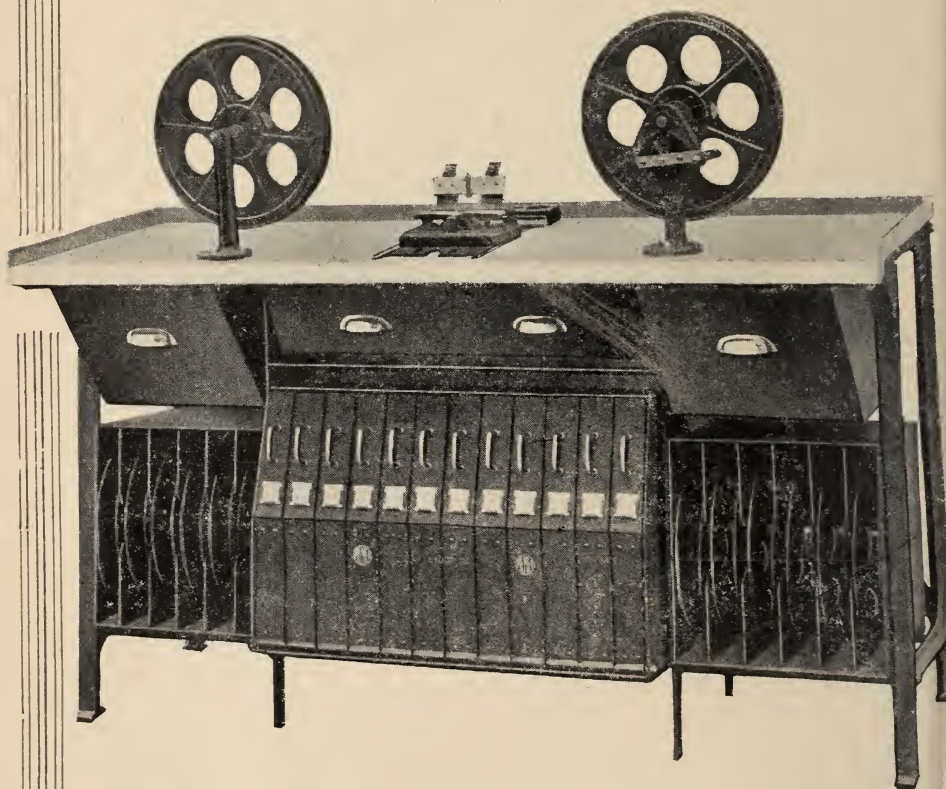
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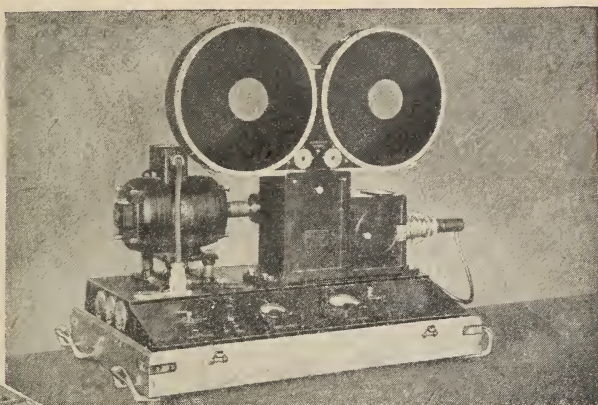
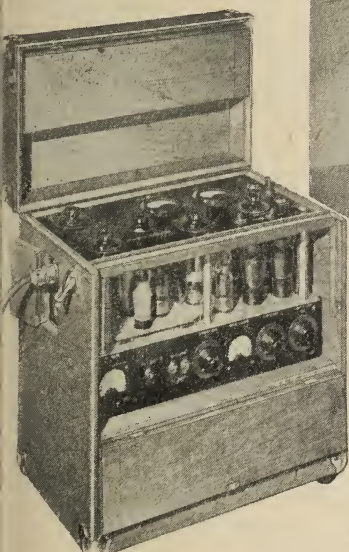
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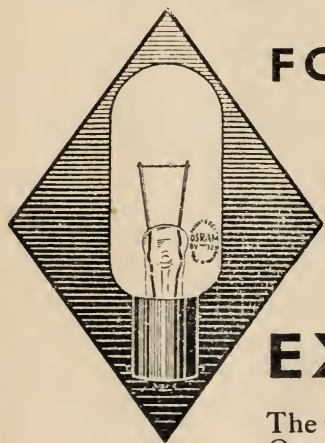
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BRITISH KINEMATOGRAPHY

The Journal of the British Kinematograph Society

VOLUME TWELVE, No. 3.

MARCH, 1948

PRESIDENTIAL ADDRESS

I. D. Wratten, F.B.K.S., F.R.P.S.*

Read to the British Kinematograph Society on December 17, 1947. The paper which followed, entitled "Modern Masking Methods in relation to Colour Kinematography," by D. A. Spencer, Ph.D., F.R.P.S., will be printed shortly.

THIS is the second year in which I have had the honour of presenting a Presidential Address. Tonight I propose to talk about the B.K.S. Those who were present at the time may remember that, on the occasion of my last address on January 15, 1947, I read a document prepared by the Council entitled "A Five Year Plan of Progress." In general, your Council is adhering to this plan as closely as conditions permit, and it will be well worth while to examine our present position.

Membership

The membership of the Society continues to show an encouraging increase. In January, 1946, the total membership stood at 705, and at the present moment it is well over one thousand. I am also pleased to be able to report an increase in Patron Membership, which now includes no less than 43 firms, as compared with 24 in January, 1946. I am sure you will agree that this shows a satisfactory rate of progress.

I would like to take this opportunity to thank our Patron Members for their continued support, and to invite all firms in the industry to apply for this form of membership.

During the early part of 1948, Certificates of Fellowship, Membership, and Associateship, will be sent to members.

Journal

Our Journal, under the title *British Kinematography*, is now published monthly, and while this represents a considerable expenditure of both effort and money, it is the opinion of your Council that the monthly Journal is one of the most important of the Society's activities. I must add that it is being widely read in many countries overseas. A great deal of hard work has been, and is being, done by the Journal Committee, but they would be the first to agree, that the main credit for the successful launching of a monthly Journal must go to our editor, Mr. R. H. Cricks, ably assisted by our Assistant Secretary, Miss S. M. Barlow, who has been responsible for advertising contracts.

There are many problems to be solved before *British Kinematography* attains the high level we have in mind. Among the most prominent

*Kodak, Ltd.

these problems is the shortage of paper supplies, but I am confident that our Journal Committee, under the chairmanship of Mr. Geoffrey Parr, is fully competent to meet and in time to overcome these difficulties.

Lecture Programme

The lecture programme for this session covers a wide field and has been designed to accommodate the varied interests of our members. Including Divisional meetings, joint meetings with other Societies, and the programmes for our Manchester and Newcastle Sections, no less than forty-three meetings have been arranged for the present session.

I am happy to report that, through the generosity of a member of our Council, a silver medal has been offered for the best paper read at a Society or Divisional meeting during this session. The difficult decision of naming the winner of this award will rest with the Council. The donor of the medal asks to remain anonymous, but in any case, he receives our warm thanks for his generous and kindly gift.

Educational

Insofar as educational activities are concerned, the Society continues to take an active interest in the various schemes under consideration at the present time. The two-year course in cinematography at the Regent Street Polytechnic continues, as do the refresher courses designed for persons already in the industry.

Since its earliest days, the Society has taken a great interest in educational work, and any scheme designed to raise the technical status of our industry may be sure of active and sympathetic consideration by the Education Committee, under the chairmanship of Mr. A. G. D. West.

Library

The new library has taken shape and is now very definitely in being. This service to our members is well appreciated, judging by the use that is being made of it. Within the last few weeks a catalogue has become available. The Library owes its successful initiation to the energetic enthusiasm of Mr. Rex B. Hartley, and to the Library Committee over which he presides.

Standards

On the question of Standards, the B.K.S. is very actively associated with the British Standards Institution at the present time, and is adequately represented on all B.S.I. Committees. At the present moment there are in operation about fourteen B.S.I. Committees on motion picture subjects.

Divisions and Sections

As you know, the formation of Divisions of the Society some years ago was intended by the Council to further the interests of individual groups of members, who rightly wished for more meetings on subject matters restricted to a narrower field than it would be possible adequately to cover when considering the wide fields of activity of the industry as a whole.

The three B.K.S. Divisions : Theatre, Film Production, and Sub-standard, have been uniformly successful in arranging meetings to suit the requirements of their particular members, and I consider that the formation of these Divisions has proved to be a wise move.

The Manchester and Newcastle Sections are at the moment subsidiaries of the Theatre Division, but consideration is being given by Council to the possibility of forming Branches of the Society at these places. This matter

is at an early stage and it would be injudicious to anticipate the decision of the Council at the present moment, particularly since the problems involved are rather intricate. However, I must congratulate Mr. A. Wigley, of the Manchester Section, and Mr. E. Turner, of the Newcastle Section, on the excellent work they have put in on behalf of their Sections.

The Fellowship

I come now to an item which has been tackled with extreme caution by your Council. I refer to the Fellowship.

The finalised regulations for conferment of the Society's Fellowship have now been published* and an approved form of application will shortly be obtainable from the offices of the Society. I must add that, except in special circumstances, only five Members can be admitted to the Fellowship in any one year, and that its conferment must be considered as a high honour, not lightly to be attained.

Upon the recommendation of the Fellowship Committee, the Council were recently pleased to confer the Honorary Fellowship upon Mr. P. H. Bastie, our Honorary Treasurer, and Mr. A. G. D. West, our Past President, in recognition of their services to the Industry.

Co-operation with other Bodies

The British Kinematograph Society has always been interested in co-operating with other bodies for the purpose of raising the technical efficiency of our industry. At the present time, this co-operation is quite extensive and I feel that it should be more widely known.

I have already mentioned our relationship with the British Standards Institution, and I believe that the Joint Meetings of our Film Production Division with the Association of Cinema and Allied Technicians are also well known. Our relations with the Royal Photographic Society are closely maintained, and here I should mention the Newman Memorial Award, handled jointly by the two Societies, as is the annual Newman Memorial lecture; both award and lectures are designed to honour the memory of the late A. S. Newman, one of the great pioneers of cinematography, who happily occupied a high position in the Councils of both Societies.

We are well represented on the committees of the British Film Institute, with whom we closely co-operate on technical matters. Your Council has noted with pleasure and interest the formation of the British Film Academy, and it is expected that both bodies will co-operate on technical matters of mutual interest.

The Society is recognised by H.M. Home Office as an unbiased representative of the Industry's technical aspects, and a committee is now finalising a report on the new draft Cinematograph Regulations. We enjoy excellent relations with the Television Society, whose library is temporarily installed at our offices. On the occasions of our Joint Meetings with this Society, the subsequent discussions have always been lively, entertaining and instructive.

The Kinematograph Renters' Society and the Cinematograph Exhibitors' Association, both Patron Members of this Society, maintain an active interest in our proceedings. In the last year we have been able to be of service on the serious matter of film mutilation, and a B.K.S. Film Mutilation Committee presented a report which throws a new light on this thorny problem. The matter has now been taken a step further, and a series of booklets to be published by the B.K.S., with the co-operation of the K.R.S. and the C.E.A., will shortly be prepared.

**British Kinematography*, October, 1947

At this point, I must mention that our Foreign Relations Committee, under the chairmanship of Mr. Cabirol, has made important contacts with technical bodies in fourteen countries. In the present state of the world, it is unlikely that the Foreign Relations Committee can go much farther than to maintain these contacts for the time being, but I am hopeful that the cordial relationship which has been established with the Association Française des Ingénieurs et Techniciens du Cinéma, of France, will eventually lead to co-operation on the widest scale between the two Societies.

In this connection I have great pleasure in welcoming Mr. J. Vivié, the Secretary of this French organisation, whom I ask to convey our cordial good wishes to his colleagues in France.

Society of Motion Picture Engineers

As a member of both the B.K.S. and the Society of Motion Picture Engineers, I have always wished to see a greater measure of co-operation between these two Societies. All things considered, the B.K.S. and S.M.P.E. have similar ideals and aspirations, and I have been awaiting an opportunity to open discussions with the S.M.P.E. on the means by which co-operation can be facilitated.

Quite recently we were able to initiate these discussions, by the fortunate chance that Mr. A. G. D. West, our Past President, found sufficient time to attend the S.M.P.E. Autumn Convention in New York, where, in addition to reading two papers before the Convention, he had full discussions with the responsible officers of the S.M.P.E. on the question of closer co-operation between the two Societies. Mr. West's report on these meetings, which was considered at our last Council meeting, may represent an important milestone in the history of the two Societies.

In the first place, it is clearly established that the S.M.P.E. are equally desirous of closer co-operation, and, secondly, that many of their problems are similar to those which face our Society. As a consequence of this meeting, a method of co-operation on some important matters has been agreed. It will I think be worthwhile to mention some of these matters tonight. It has been agreed that each Society shall have the right to publish a paper in full from the other Society immediately after that paper has appeared in the original Journal; for example, the S.M.P.E. will study all papers appearing in *British Kinematography* upon its arrival in New York, and will if it wishes, publish the paper in the *S.M.P.E. Journal*, or alternatively give an abstract or reference. It is, of course, quite true that this practice may result in an appreciable interval between the appearance of a paper in the two Journals, but it is equally true that it avoids the risk of a prior publication in the wrong Journal.

Under ideal circumstances, it has seemed to me that an arrangement might be made to ensure that each Active Member of the S.M.P.E. would receive *British Kinematography* and that each Corporate Member of the B.K.S. would receive the *S.M.P.E. Journal*. Unfortunately, such an arrangement is impracticable for the time being, due to paper shortage and the difficulties of sterling-dollar transactions.

In his meetings with the Officers of the S.M.P.E., Mr. West suggested that as an interim procedure, an exchange of Journals between the officers of the two Societies should be arranged. This proposal is possible of immediate achievement, and it has been agreed that the Secretaries of the two Societies will in future send each other twelve copies of their Journal each month for distribution to the officers of the two Societies. We are sure that this will be a satisfactory way of bringing to the notice of each Society the activities of the opposite Society.

Another matter which I asked Mr. West to investigate, was the possibility of the two Societies keeping in close touch on the initial and subsequent stages of any matter which is to be the subject of standardisation. Mr. West in his report to the Council states that this suggestion was welcomed with enthusiasm, and it has now been agreed that a monthly letter will be exchanged by the Secretaries of both Societies, giving a brief statement on what is happening on each side in respect to Standardisation.

I have perhaps dwelt too long on the subject of B.K.S.-S.M.P.E. co-operation. My excuse is that it is a subject in which I am very interested. Before leaving the matter, I would like to express our best thanks to Mr. West, our representative in these discussions with the S.M.P.E.

Conclusion

In this rather rapid survey of the activities of your Society, I am quite conscious of the fact that I have given you an incomplete picture of its work and aims. I have not, for instance, given you a clear description of the work being done by many committees. However, I believe I have said enough to allow you to visualise the progress of the B.K.S., which has developed very strongly from the days when it had a membership of some two hundred and fifty persons. With its present membership of over a thousand and its vastly increased ramifications, the Society will continue to grow with the industry it serves so willingly.

I would like to pay a personal tribute to our Vice-President, Mr. W. M. Harcourt, our Honorary Treasurer, Mr. P. H. Bastie, our Honorary Secretary, Mr. E. Oram, and to all members of our Council and Divisional Committees. These members have given and are continuing to give unselfishly of their time to forwarding the interests of the Society. I can assure you that the operation of a Society such as ours is not a simple matter in these difficult times.

It has always seemed to me a strange thing, that not more than thirty or so members out of a total membership of over a thousand give freely of their services; I do not believe that this is due to a lack of interest on the part of our members. It is true that the Society exists for the members, but is equally fair to say that in the final analysis one has to put something into the Society if one wants to get something more out of it.

You will naturally want to know how you, as a member, can serve your Society. Probably the best way is to remember that the B.K.S. is a forum, where views on all technical matters can be freely expressed, and where you can meet your fellow technicians to discuss problems of common interest. If you have constructive suggestions to make regarding the operation of the Society, by all means see that our Secretary is informed. Remember too, that our membership should stand at two thousand, and although we shall undoubtedly reach that figure in due course, the desired result will be accelerated if each member proposes one new member each year. Remember, above all, that it is your Society.

In addition, let me draw to your attention our staff, who, under the direction of our Secretary, Mr. R. H. Cricks, are working so energetically to cope with the ever increasing work of the Society. Unsung and rarely heard, they contribute much to the success of the B.K.S.

Finally, let me record our appreciation of the splendid services of our member, Mr. J. S. Abbott, whose ready help has at all times been freely available to the Society.

May I express the conviction that the Society will continue to find a useful place in the British Motion Picture Industry, and that its usefulness to the Industry will be adequately acknowledged.

PREPARATION OF THE FINAL SOUND TRACK

Summary of papers read to a joint meeting of the British Kinematograph Society with the Association of Cine-Technicians on March 19, 1947. The papers are more fully reported in the "Cine-Technician."

I. THE DUBBING EDITOR

C. Tomrley*

IN a well organised studio, with good continuity of production, the dubbing specialist can so organise the department and procedure as to effect very real economies in time and money. Unfortunately, often the first time the dubbing editor sees the picture is during its first screening.

One of the first tasks after viewing the production is to order from the library the most obviously needed effects tracks: cars pulling up, doors closing, revolver shots. Each reel of the cutting copy is run on the Moviola and marked to indicate where effects are to be added or removed. At the same time, dubbing sheets are prepared to show dialogue or action cues and the distribution of the effects tracks.

The use of music and effects is discussed. Probably the dubbing editor will receive the reels out of sequence just as they are completed: "Picture missing" inserts may be cut in to indicate inserts, and montage sequences or library shots not yet selected; the track will be in a similar condition, with background recordings cut into by backgroundless dialogue tracks, or just unmodulated track to cover inserts.

Assembling Tracks

Assuming six dubbing heads are available, six columns on the dubbing chart would be headed, "Dialogue," "Music," and "Effects A, B, C, D." Dialogue refers usually to the original studio recorded track; post-synced tracks are put on one of the other tracks for better control. It may be necessary to make volume or filter adjustments to any one of these tracks, and such sounds should be separated by blank spacing. A list of new recordings required must be prepared.

A wall progress chart is essential, giving such data as to what reels have been received and when, dates when sent in for negative cutting, and when prints have been received.

Meanwhile, the music department will be demanding sections for timing; it is sometimes necessary to dupe whole reels in order to make the cutting copy available for negative cutting. There are library tracks to be run, theatre bookings to be made, the casting department to be instructed to call artistes for post-syncing.

The dubbing editor's job is harassing and nerve-wracking. He must be an imaginative and creative technician and rarely gets any screen credit. His work is the last process in a long chain of processes, many of which have gone well over their scheduled time.

The manufacture of special sounds may tax one's ingenuity. In "King Solomon's Mines," the sound of boiling lava was produced by placing a microphone close to a large bowl of boiling porridge. The noise of a Chinese crowd was produced by running an English track backwards, speeded up.

II. THE MUSICAL ASPECT

Bretton Byrd†

THE most successful films are usually those which produce the greatest reactions on the human emotions. Perhaps the most important and effective aural medium in this respect is music. Usually, film music can be

*Technicolor, Ltd.

†Burnham Productions

divided into two categories : (a) positive or factual music, being that which forms part of the story ; and (b) incidental music.

After the selection of the " story " music, the first decision to be made is that of the best method of shooting and recording, and it is to be deplored that too little consideration is devoted to this important factor.

Methods of Recording

There are three methods of recording music : pre-recording and playback ; direct floor recording ; and guide-track and post-synchronisation. Playback allows the greatest latitude to everyone except the artist. Direct recording, although allowing artistic spontaneity, restricts the operation of almost every department. Guide-track and post-synchronisation comprise a combination of conditions embodying both the virtues and disadvantages inherent in the first two systems.

Generally it is safe to assume that all music and songs in which a strict tempo is maintained are suitable for playback work. The sense of reality produced by direct recording becomes more evident as the music becomes more involved ; the objections are the difficulty of maintaining efficient microphone and acoustic conditions and the limited mobility of the camera due to congestion on the set. It is generally considered that direct recording of musical sequences should be undertaken only as a last resource.

Subject to the foregoing limitations, pre-recording, under ideal acoustic conditions, should be the first choice.

Floor Playback Work

Since post-synchronisation of accompaniments and music is carried out with the aid of guide tracks or playbacks, the same limitations obtain as with floor playback work. One qualification is that the conductor has to convey to the orchestra that which the artist is able to do spontaneously. In vocal song sequences, the voice can be recorded with a lost ghost accompaniment, and the most effective accompaniment can later be post-synchronised.

Synchronising Music

Dance taps or rhythmic sounds should not be post-synchronised, as the sync necessary between sound and sound is far more critical than that between sound and picture. Great care should be taken when lining up a dance tap track with an accompaniment track ; an error of even three perforations is sometimes noticeable.

In the preparation of playbacks or guide tracks for floor work lead-in plops, spaced in time with the music that follows, should precede every musical start which follows an indeterminate pause. If the director interrupts the musical continuity to introduce an additional dialogue shot, it should be positioned so that it occurs at the end of a complete musical phrase.

To build up incomplete playback tracks, guide track sections may be measured and plopped in time with the additional music and suitably intercut. In order to facilitate identification, synchronisation points should be marked on the tracks in consecutive numbers. Direct sound cuts should be made at points immediately preceding an accented beat or change of musical character.

I have evolved a synchronising device, in which an exact duration of music is written on each stave, and a line of light visible through the paper is caused to traverse the stave in the same period. The use of this machine enables perfect synchronism without film projection. Another device will cause the plops on the guide tracks to light up neon lamps visible to each member of the orchestra.

Actual Recording

Every possible positioning of the instruments has been tried in recording; in order to facilitate the positioning of the instruments I have composed a special piece of music, entitled "Balance," in the orchestration of which occurs every possible combination.

III. DUBBING

W. S. Salter, M.B.K.S.

WHEN all the missing tracks are provided, there remains the important task of modifying the characteristics of these tracks. This may necessitate re-recording under strange conditions, for instance as telephone speech; echoes are simulated by means of the reverberation chamber.

The actual process of dubbing consists broadly of blending individual tracks, each reproduced upon a separate dubbing head, the outputs of the various heads being controlled by a mixer console; the combined sound output then passes to the sound camera. The console should be placed in the main theatre of the studio.

Equalisation

Each of the faders will in all probability have in its circuit an equaliser. Equalisation means the deliberate alteration of the recording characteristic, necessitated by several factors. One is the desirability of not having a large difference of bass content between different voices; a voice tending to shout loses a considerable amount of low-frequency content, and an intimate conversation contains an excess of low-frequencies. Errors on the floor due to perspective and microphone placing can within limits be corrected.

Simultaneously with this work the imaginative side is progressing: cues for music to be faded in or out, crescendos or diminuendos worked out to a split second to get over certain words, the arrangement of effects and fill-ins, all of these have their changes in level and equalisation.

A recent problem is the pick-up of mains noise due to the increased lighting intensities needed for colour. An electronic filter has been produced which will suppress such frequencies, leaving dialogue unimpaired. The noise from the flames of arcs cannot be suppressed. Yet another adjustment may be a compressor circuit, used possibly to compensate for errors on the floor or to obtain certain dramatic effects.

The paper was followed by the projection of a reel from "The Magic Bow," in course of which Mr. Salter explained the many examples of dubbing found in it.

DISCUSSION

Mr. T. S. LYNDON-HAYNES: Mr. Byrd has told us that a stronger appeal is made to the emotions through the ear than through the eye. I have found rather the reverse.

Mr. BRETTON BYRD: As an example, I would give the effect of the sight of a bomb dropping with the accompaniment of the roar of the explosion, the noise of falling debris and women's screams. That I am sure would have a far greater emotional effect than the mere sight of a bomb falling.

Mr. C. WHEELER: The first real use of playback was in "One Night of Love." Playback went through everything. There was a close-up of a diminutive figure, but

with the original background track to it. There is a loss of realism in any production in which that sort of thing is used.

Mr. BRETTON BYRD: Tracks used for playbacks should be separate tracks.

If you have a singer accompanied by an orchestra, obviously in a close-up picture, the singer will stand out predominantly.

Mr. TOMBLEY: I would like to refer to something I said about courageous use of sound. I remember an effect by Hitchcock in "The Thirty-Nine Steps." There was a scene in which a woman came in and opened her mouth. But no scream issued from it. We used the shriek of a train's whistle as it came out of a tunnel.

PROBLEMS OF 16mm. PROJECTION

A symposium arranged by H. S. Hind, A.M.I.E.E., M.B.K.S., A.R.P.S., and read by him to the B.K.S. Sub-standard Division on March 26, 1947.*

I. MAINTENANCE OF EQUIPMENT

W. J. Humberstone, M.B.K.S.†

THE servicing of talking picture equipment is one of the most important links in a chain. Satisfactory maintenance of road show equipment requires :—

1. An adequate stock of spare parts properly warehoused.
2. A properly equipped workshop.
3. An efficient emergency service.
4. A well trained staff.

Spare Parts

The provision of spare parts is facilitated if the equipment used is of the same make, or at the most does not exceed two kinds.

Spare parts can be divided into groups of consumables and non-consumables. Consumables represent lamps, valves, photo-electric cells, belts and film cement, non-consumables being lamphouse condensers, screen surfaces, gears, bearings, shafts, screws, capacitors, motors, governors, and transformers.

Stock requirements of consumable parts are fairly easy to estimate if records are maintained, but non-consumables require care and the maintenance of an adequate stock so stored that the part required can be obtained in a minimum of time.

Stock record cards should be kept so that stock levels can be maintained. Such cards enable an item to be properly identified, the initial amount of stock and subsequent additions are on record, the consumption is noted and a minimum stock figure is pre-set.

All goods taken from stock must be covered by papers properly authorised, and worn or defective parts should be returned to stores.

The Workshop

A properly equipped workshop should be housed in a room with plenty of windows and large enough to accommodate at least one 16 mm. projection equipment set up to operate and project a picture of about 30 in. in width. There should be enough space to accommodate the various benches, cupboards and cabinets.

The equipment is governed by the number of machines to be serviced, and test films for picture and sound must be provided. The provision of a service manual setting out the order of servicing is essential. An insulation tester (megger), an inductance and capacity analyser and at least one all-purpose meter will be required to enable a small workshop to carry out its job.

Where greater workshop facilities are required, a comprehensive range of drills, taps and dies will be necessary. Undoubtedly a drilling machine, a lathe (motorised) and a grindstone, together with a greater range of meters are an advantage. It may be considered that an oscillator with a proper attenuator control box is justified.

Routine Inspections

Routine inspections carried out in definite order as laid down in a service manual prevent wasted effort in going over ground already covered and also

*Sound Services, Ltd.

†Western Electric Co., Ltd.

minimise the possibility of overlooking certain items. The mechanical side must come first because any mechanical blemish invariably interferes with the sound reproduction.

Proper work sheets should be made out. Intelligent use of these quickly reveals any inherent weaknesses in the equipment, or its operation, and also shows the life cycles of the various components.

A trouble analysis chart recording every fault is also helpful. Faults that caused a performance to be abandoned could be marked up in red, other faults could be marked in blue, showing at a glance those corrected on routine inspections which might have resulted in a breakdown.

If the territory service is large, it can be divided up into areas and coded showing where the majority of faults occur. It will also reveal life cycles and weaknesses in the equipment and also the ability of a particular engineer.

Emergency Service

There must be an engineer on call at all times day or night with facilities at his disposal enabling him to tackle any emergency that may arise, including a complete 16 mm. equipment to repair a major breakdown.

Generally speaking, field servicing of equipment should be avoided where the equipment is mobile, because the facilities available are poor. Contacting the unit may be delayed through various causes and the work carried out is often on makeshift lines. All regular servicing is better done at base where the right tools and a full range of spares is available.

II. REQUIREMENTS AND MAINTENANCE OF PRINTS

J. W. Hissey, M.B.K.S.*

THE first essential requirement is a good negative, in first class physical condition and free from oil, dirt and abrasions.

The positive stock, preferably fine grain, must comply with relevant B.S.I. specifications, the non-inflammable film support perfectly transparent, of adequate flexibility, and of uniform width and thickness.

The emulsion must have passed through the various stages of processing to ensure that—

1. There is no danger of it separating from the base.
2. It contains sufficient moisture content to maintain its heat resisting properties.
3. It has a melting point of not less than 140° F.
4. It has been sufficiently hardened to withstand normal usage.

All new prints should be subjected to a viewing and sound test prior to release.

Maintenance of Prints

Processed prints must be stored in damp-free conditions at the proper temperature to guard against shrinkage of the base and reduction in flexibility owing to loss of moisture content.

Ideal storage conditions comprise :

1. A constant temperature of between 40° and 50° F. and a relative humidity of between 40% and 50%.
2. Storage racks should be away from any source of heat such as radiators, etc.
3. Prints should be stored preferably in metal or wooden cabinets or on wooden shelves and in conditions permitting free circulation of the air.

Prints should be carefully examined after use or at regular intervals.

*G. B. Equipments, Ltd.

Rewinders and Splicing Machines

Hand or electrically operated rewinders can be used. The spool supporting arms should be square and firmly mounted and in alignment to eliminate possible rubbing of film and facilitate even winding.

Splicing machines should be of good design and maintained in a clean serviceable condition, to ensure that the blades have sharp cutting edges so that the film is cut clean and square.

Splices must be neat and cleanly made, and the emulsion must be completely removed to provide a 100% fusion of the bases. A good quality film cement is necessary. Any uneven or dirty joins should be removed.

The regular cleaning of films will help to prolong their life, the film being first passed through a bath of trichlorethylene or carbon tetrachloride, and then between felt pads and finally over a series of revolving brushes and rollers.

Prints which have sustained surface defects not penetrating the emulsion, can be improved by waxing treatment.

Avoiding Damage in the Field

The most important factor is to take all possible measures to ensure that films are supplied in a good serviceable condition.

To guard against damaging green stock and to facilitate the passage of the film over the sprockets, gate, sound drum, etc., prints should be subjected to a hardening treatment. This results in a high glazing of the delicate emulsion and imparts a transparent lubricant to the stock, thus also improving durability.

Films should be enclosed in cardboard or metal containers and despatched in strong fibre waterproof cases with closely fitting lids. Where no containers are used, the loose end of the film should be made secure. Films should be supplied evenly wound ready for use, according to requirements, with the title, catalogue number and numbers of reels clearly indicated on the head leaders as well as the containers.

Head and foot leaders are essential on all reels to prevent damage to the front and end sections. A minimum length of 5 ft. head leader is necessary to enable the film to be laced up in the machine, and provides sufficient length for checking purposes. 18 in. to 24 in. of blank film is usually suitable for foot leaders. (The B.S.I. is at present considering the standardisation of leaders based on recommendations submitted by the B.K.S.)

In no circumstances should distorted spools be used. The spindle hole should be checked for excessive wear.

Detailed records of every reel, covering perforations, joins, track and picture quality, should be maintained. Films should be examined immediately on their return from the operator and in the event of fresh defects being observed the operator should be notified without delay. Operators who continually damage films are a constant cause of anxiety and every endeavour should be made to give them tuition in methods of safeguarding film.

Film Damage

Defective stock has an almost negligible bearing on film damage. Particular consideration should be given to make the cleaning and care of the projectors a simple matter.

All parts with which the film comes in contact should be highly polished and sufficiently hardened to eliminate wear. All rotating parts should be mounted on ball races and designed to facilitate servicing and cleaning.

All purchasers should receive expert instruction in the operation and maintenance of their equipment and care of film, and a test lacing length of film should be supplied with each equipment.

Operators of 16mm. projectors should possess a booklet on the care of film and a test lacing length of film to check machine for serviceability. Their equipment should be regularly overhauled.

THE OPERATOR AND HIS PROBLEMS IN THE FIELD

George East*

THE mobile projectionist is immediately thrown upon his own resources when out in the field, and will be called upon to handle all sorts of problems and people—the most important being the public. Commonsense is of paramount importance and the mobile projectionist needs plenty of it if he is to be successful.

Electricity Supply

Arrived at his location, our projectionist will ascertain the nature of the electricity supply by locating the meter. In most cases it will be 230 volts A.C., 50 cycles, but it might be 110 volts A.C., 100 cycles or a D.C. supply; in the latter cases a petrol electric generator and a converter are required respectively.

There is a stupid and dangerous practice, somewhat prevalent, of connecting the equipment to a lighting socket. A lampholder is not designed to carry the current required, and there is the risk of some helpful person turning off your switch with the lights.

It is not uncommon for halls to fit shilling-in-the-slot meters, and the projectionist should be prepared for any emergency.

The Screen

The base of the screen should never be less than 5 ft. 6 in. from the floor, to permit an unobstructed viewing. A properly equipped mobile film unit will travel with sufficient black draping for the screen, screen supports, and speaker together with its supports.

The brightness of the picture on a glass beaded screen falls off considerably as the angle of viewing is increased, *i.e.*, if it is viewed from the end of a wide row of seats. The silver screen is very similar, and in both cases it is essential that the seating be carefully arranged so as to avoid anyone viewing the picture at an angle of more than 25°. The ordinary white matt surface does not suffer from the same disadvantage and the arrangement of seating is considerably simplified.

Speaker and Projector

The speaker line *must* be hung or run above the heads of the audience and out of their reach. This is as much a safety point as for protection for the cable. Not less than 120 ft. of speaker line should be carried with the equipment.

The exact position of the projector has next to be decided. The most efficient position is dead in line with the centre of the screen and high enough to clear the heads of the audience. The projectionist must set up his projector on the right and as near the doorway as possible. This will allow him full control over the entrance. The unit must be equipped with at least three lenses of varying focal lengths, say 2 in., 2½ in. and 3½ in.

During the winter period the projectionist should run his equipment with

*Travelling Films, Ltd.

lamp and sound "on" for at least 10 minutes prior to the show to allow everything to warm up and to dry out any condensation.

Seating, a most important item, largely contributes to the success of the show, and the type of screen, local police regulations and shape of hall should be taken into consideration.

The Public

The projectionist must remember that the responsibility for the whole show is his, and in addition to operating, he must co-ordinate everything that goes towards a first class show.

The audience should be directed to their seats by an attendant, but some seats should be kept near the entrance for possible latecomers. Always start the show at the appointed time.

DISCUSSION

Mr. H. WALDEN : In regard to the cleaning of films, Kodak recommend a special material for Kodachrome. To compensate for the directional properties of the beaded screen, I devised a stand which would enable the screen to be tilted.

Mr. H. S. HIND : I must disagree with Mr. Walden on the question of beaded screens. Unlike a mirror, a glass beaded screen reflects the light back to its source.

The reason is that it consists of a large number of small glass beads, and each one is practically a sphere of glass.

Mr. J. P. J. CHAPMAN : For cleaning the film, tri-ethylene chloride should be used, but it is highly toxic. For waxing films, I have made a machine in which two felt-covered rollers are lubricated by a mixture of carbon tetrachloride and 20% spermaceti; this lubricates only the edges of the film.

BOOK REVIEWS

THE YEAR BOOK OF THE ASSOCIATION OF CINEMATOGRAF AND ALLIED TECHNICIANS. Published by A. Vernon Free & Co., Ltd.

"This book," writes Mr. Anthony Asquith in his introduction to the first year book issued by the Association of Cine-Technicians, "is an experiment." The comment is an explanation of limitations : there is no need for it as an apology, for seldom has a first effort stood so little in need of any apology.

The British film industry is large enough now to justify a year book of hundreds of pages. Naturally, in their first effort of 79 pages, A.C.T. had made no attempt to give everything. What is surprising, is that they have given so much so well.

Being intended primarily for the use of A.C.T. members, the technical section contains information of practical importance in picture making, much of which is not otherwise available without research. For instance, cameramen and producers will find the section giving weather statistics for various areas in the British Isles of considerable value. In the technical section, there are sub-sections dealing with rawstock and colour processes.

All year books suffer a little from developments that occur between the time of compiling the copy and the book's issue from the Press. It is in gentle reminder of

this that we must observe that the Cinematograph Exhibitors' Association moved its address last summer. J. C. WARBIS.

MAGIC SHADOWS. Martin Quigley, Jr. 191pp. Georgetown University Press, Washington. D.C. \$3.50.

This very readable book (whose author is editor of the *Motion Picture Herald*) bears evidence of an erudite study of historical records, tracing the development of the magic lantern from the 17th century.

Notwithstanding that the book is subtitled "The Story of the Origin of Motion Pictures," it is not until halfway through it that mention is made of the photography and synthesis of motion, when yet another claimant arises to the title of "Father of Motion Pictures" : the Belgian scientist, Plateau, whose work on stroboscopic phenomena seems to have preceded that of Roget.

Thirty pages only are devoted to tracing the history of the film. Credit for the development of cinematography is very fairly apportioned to a dozen inventors : in particular, the contributions of Edison and Friese-Greene are critically, but justly examined (although the account of Friese-Greene's death is inaccurate).

There is room for a sequel to this book—an expansion of the last thirty pages.

R. H. CRICKS.

OPTICAL APPARATUS FOR PROJECTION

A. Howard Anstis, M.B.K.S., A.Inst.P.*

Read to the B.K.S. Theatre Division on March 16, 1947, to the Manchester Section on February 3, 1948, and to the Newcastle-on-Tyne Section on March 2, 1948.

EVERY projection system must consist of a light source and collecting system, the object to be projected, the projection lens and a screen. In the design of the optical system the initial considerations are :—

- (a) The required magnification of the object being projected.
- (b) The brightness required in the image.
- (c) The quality of reproduction, which is bound up with the resolving power of the projection lens.

Focal Length of Projection Lens

The dimensions of the picture frame are standard, so that if the screen size is fixed this governs the magnification immediately, the magnification being the width of the screen, say, divided by the width of the projection aperture. If then the throw is fixed, the focal length of the projection lens follows at once.

The focal length of a projection lens is given by the following formula :—

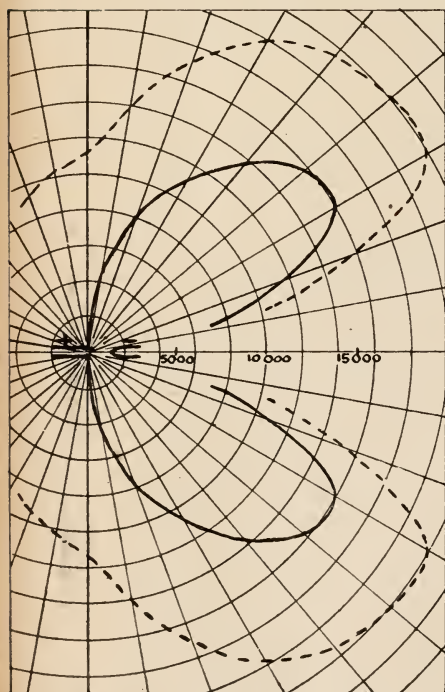
$$f = \frac{D \times W}{L} \quad \text{where}$$

f = focal length of the projection lens

D = throw from lens to centre of screen

W = width of projection aperture (0.825 in.)

L = width of screen



(Courtesy of Ship Carbon Co., Ltd.)

Fig. 1. Horizontal Distribution of Candlepower from 8mm. H.I. Positive Carbon, burning at 60 amps. 38 arc volts
 ----- Total Candlepower
 ————— Crater Candlepower

coming from the source at the extremities of the pick-up angle.

Light Source and Collecting System

If the source of light were a point source, the collecting system would converge the light to a point, and the gate would be situated within the apex of the solid cone of convergent light. If we assume that a D.C. arc is being used, the hot positive crater has a definite size, so the light is not converged to a point, but to a disc which is the image of the crater. This magnified image of the crater is located at approximately the plane of the gate, and it will be seen that the degree of magnification produced is an important factor.

The brightness of the spot of light on the gate will be governed by the effective angular pick-up of the collecting system and the intrinsic brightness of the source, or that is, the grasp of lumen output of the source made by the collecting system. In deciding upon the pick-up angle of the collecting system, the polar distribution curve of the light source has to be considered, as it is no use making the collecting system with a very large pick-up angle, if there is very little light

Fig. 1 shows a typical polar curve of the horizontal distribution of candle power for an H.I. arc. Where the shadow of the negative carbon falls there is no light being received by the collecting system, and no light from the crater beyond 90° from the optical axis, so that it would be no use having an ellipsoidal mirror with a bigger angular pick-up than 180° .

The candle power falls off considerably at large angles with the optical axis, but it must be remembered that the light received by zones of the collecting system depends on the solid angle subtended by the zone as well as the intensity of the source in the direction considered, and an outer zone of the collecting system subtends a much bigger solid angle than one near the axis.

$$\text{Solid angle } \omega = \frac{\text{Area of Surface}}{(\text{distance surface to source})^2}$$

The steeper the angle of the cone of light received by the gate, the larger must be the relative aperture of the projection lens to accommodate all the light passing through the gate.

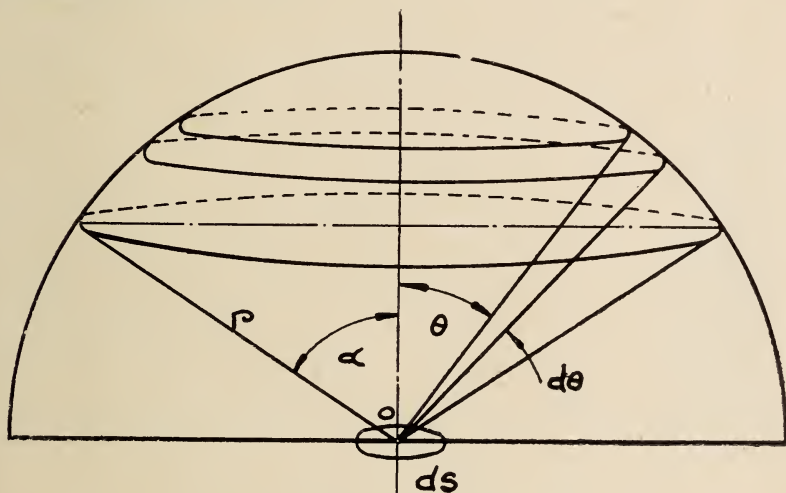


Fig. 2. Hemisphere of Light Distribution

From these remarks it will be understood that the magnification of the collecting system, its angular pick-up, the carbon crater size, the polar distribution of light from the crater, and the relative apertures of the collecting system and the projection lens, are all inter-related. It is not possible to alter any one of these factors without altering the efficiency of the designed system.

The Projection Lens

We next come to the projection lens, on which the final quality of reproduction ultimately depends. We first have to provide a lens of large enough diameter to ensure that all the light passing the gate will be received by it, and this means in the case of modern equipment, that the lens must have a relative aperture of up to $f/1.9$ or even more. The focal length of the lens may have to be as long as 8 in. or as short as $1\frac{1}{2}$ in. for back projection.

The angle subtended by the gate aperture to the lens thus varies considerably, so the lenses have widely varied covering power. This calls for a multiplicity of designs being used by the lens computer.

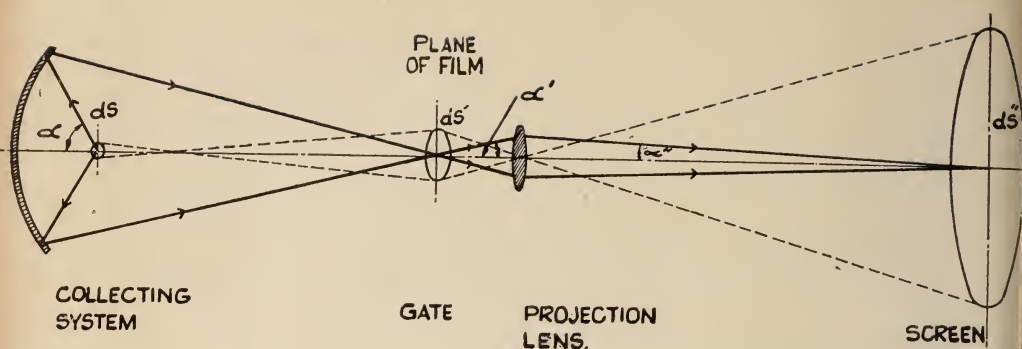


Fig. 3. Photometry of Film Projector System

The early types of projection lenses were of the old Petzval construction, which is a four lens system, the front pair cemented, the back pair uncemented. Modifications of the Petzval lens have been made to fulfil the additional conditions which have been gradually imposed upon the projection lens, and the tendency is for modern projection lenses to become more similar to photographic anastigmat lenses, particularly in the case of short focus rear projection lenses.

Efficiency of Complete Optical System

Turning now to the efficiency of the various parts of the optical system, if we imagine 100 arbitrary units of light falling on the collecting system, whether it be lenses or mirror, about 75% of this light is received at the gate after passing through the collecting system. Of this light which reaches the gate about half is wasted round the gate. The shutter removes about half of the light passing through the gate. We can assume that the film permits 75% of the light passing through the gate to proceed to the projection lens and that the transmission of the projection lens is about 70%. It will be seen from the table that only about 10% of the light incident on the collecting system is emergent from the projection lens in even a well designed system

LIGHT TRANSMISSION OF OPTICAL SYSTEM

	% (approx.)	Reducing Total to
Light incident on Collecting System	100	100
Transmission of Collecting System	75	75
Light wasted around gate ...	50	37
Transmission of Shutter ...	50	18
Transmission of Film ...	75	14
Transmission of Projector Lens ...	70	10

Theoretical Photometry of Optical Systems

It is possible by a mathematical analysis to obtain a theoretical expression for screen illumination in terms of the factors which control this illumination. Such an expression is here derived for the case of the 35 mm. projector.

It should be borne in mind, however, that this theoretical consideration only approximately fits the practical facts. One has to assume that the light source is a disc of uniform brightness, which the arc crater is not.

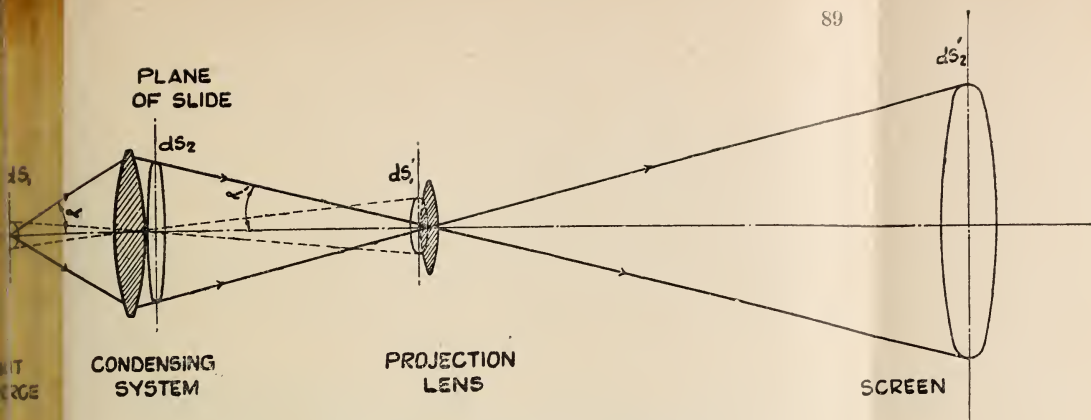


Fig. 4. Photometry of Lantern Slide Projector

that the collecting system and projector lens are free from aberrations ; and that the angular divergence of the beams is small.

However, theoretical treatment of photometry is of considerable guidance to the optical designer, and by this elementary discussion of the principles involved a very simple formula results.

It is first necessary to obtain an expression for the light radiated by a small area ds of the light source into a cone of semi-angle α .

Imagine a hemisphere described above the element (Fig. 2). The light radiated to a circular strip limited by the angles θ and $\theta + d\theta$ is the product of the solid angle subtended by the strip and the brightness of the element in the direction θ .

Let B be the average brightness in candles per unit projected area of the light source.

Area of strip is $r d\theta 2\pi r \sin \theta$

Solid angle $d\omega$ subtended by the strip at O is $\frac{\text{area of strip}}{r^2}$

$$\therefore d\omega = 2\pi \sin \theta d\theta$$

Brightness of element in direction θ is $B ds \cos \theta$

Hence light radiated to annular strip is :

$$dF = B ds \cos \theta \cdot 2\pi \sin \theta d\theta$$

The total light F radiated into the cone of semi-angle α is the integral of the last expression, so that :

$$F = \int_{\theta=0}^{\theta=\alpha} B ds 2\pi \sin \theta \cos \theta d\theta$$

$$= \pi B ds \sin^2 \alpha$$

In Fig. 3 is shown the diagrammatic layout of the film projector. Let ds be the area of the source and B its average brightness. Let ds' be the image of the source, located approximately at the plane of the film, and ds'' the area of the final image.

Total light received by the collecting system	=	$\pi B ds \sin^2 \alpha$
" " " " projection lens	=	$\pi Bk ds \sin^2 \alpha$
" " " " screen	=	$\pi Bkk_1 ds \sin^2 \alpha$

where k and k_1 are the transmission factors of the collecting system and projection lens

$$\text{Hence illumination of screen} = \frac{\pi Bkk_1 ds \sin^2 \alpha}{ds''}$$

Now by squaring the optical sine relation can be obtained the expression :

$$\frac{\sin^2 \alpha}{ds''} = \frac{\sin^2 \alpha''}{ds}$$

So illumination of screen becomes $\pi B k k_1 \sin^2 \alpha''$

$$= \frac{B k k_1 \text{ times utilised area of projection lens}}{\text{Square of distance from projection lens to screen}}$$

Or in words, the theoretical illumination of the screen is proportional to the intrinsic brightness of the source, the transmissions of collecting system and projection lens, and the illuminated aperture of the projection lens, and is inversely proportional to the square of the throw.

Efficiency of Slide Lantern

The remarks so far have chiefly related to 35 mm. film projectors, but, of course, many apply to the slide lantern. However, the photometry of the slide projector is somewhat different from that discussed for the 35 mm. projector, as the transparency is placed very close to the condenser lens.

The essentials in the slide projector are that the condenser should be of big enough diameter to cover the slide, and that the projection lens be big enough to accommodate the truncated cone of light received by it. This

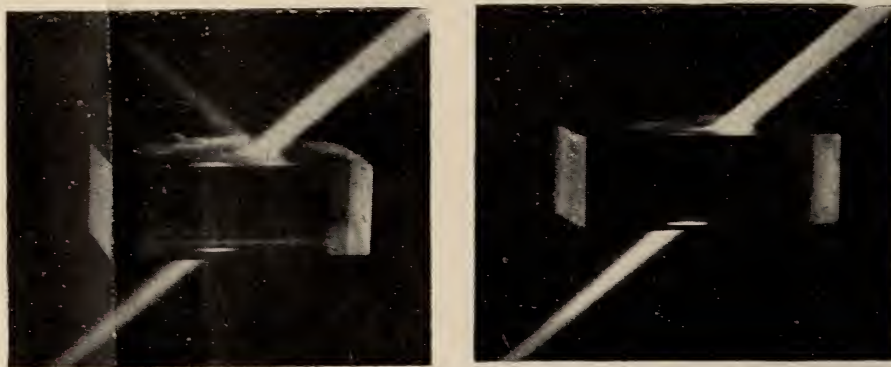


Fig. 5. Reduction of Reflectivity due to Blooming

brings in the magnification of the source produced by the condenser system, which we have already considered. The image of the source falls at about the middle of the projection lens, or to be precise, in the entrance pupil of the projection lens. Fig. 4 shows the diagrammatic layout of the system.

In spite of the altered conditions, the illumination of the screen is given by a similar relation to that obtained for the film projector :

$$\text{Screen illumination} = \frac{k k_1 B ds'_1}{L^2}$$

Where k is transmission of the condenser system.

„ k_1 is transmission of the projection lens.

„ B is the brightness of the source.

„ L is the projection distance.

and ds'_1 is the illuminated area of projection lens.

The illumination is therefore proportional to the brightness of the source, the transmission of the system, and the illuminated aperture of projection lens, and is inversely proportional to the square of the projection distance, provided, of course, that the projection lens is sufficiently large to transmit the whole of the light.

Surface Treatment of Lenses

When a beam of light is incident normally upon a glass surface, or emergent from a glass surface, about 5% to 6% is lost by reflection. As the angle of incidence increases the percentage of reflected light increases, also the higher the refractive index of the glass the bigger the loss. Fig. 5, which shows light incident upon a block of glass before and after blooming, will illustrate these harmful reflections, and how they can be eliminated, the eliminated reflected light now passing through.

There are two big advantages of surface treatment. The first is in the increase in transmission. The second is in the increase in contrast which is

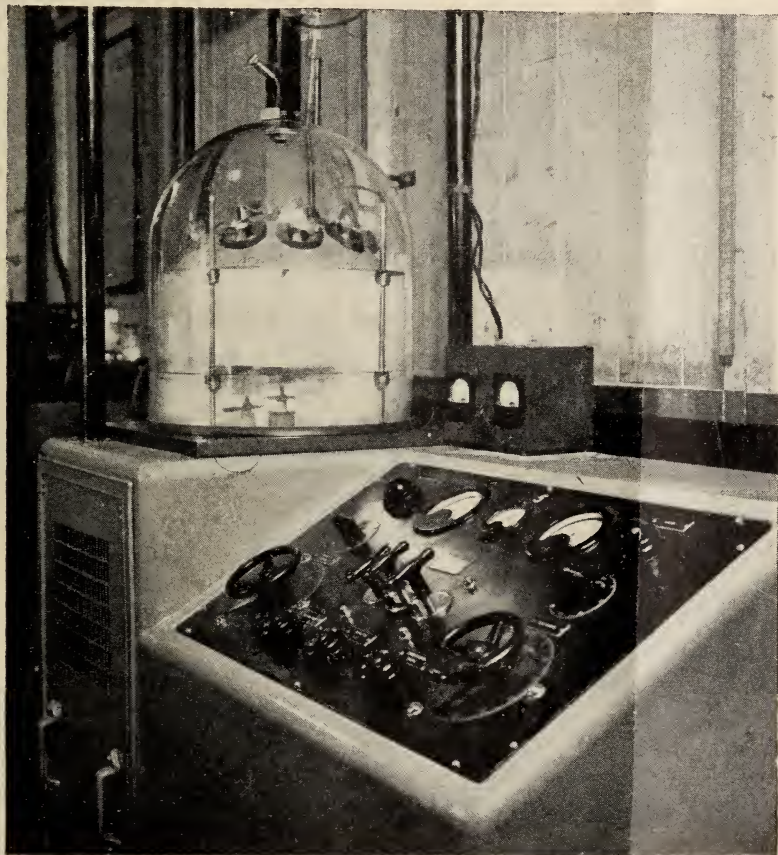


Fig. 6. Equipment for Blooming Optical Components

obtained because the light reflected from the surfaces is eliminated and does not appear as stray light in the image.

The bloom is a film a quarter of a wavelength of light in thickness, *i.e.*, about $1/10,000$ mm., and having an optimum refractive index equal to the geometric mean of glass and air. These optimum conditions for thickness of film and refractive index of film arise from mathematical consideration of the interference of light reflected from the top and bottom of the film. In order that the light reflected from the top and bottom of the film shall destructively interfere so that there is no resultant reflected light, the conditions are that the light reflected from the top of the film should be equal

in amplitude, but opposite in phase, to the light reflected from the bottom of the film.

There are broadly speaking three ways of producing the bloom :—

- (1) By etching the surface of the glass and leaving a skeleton structure of silica—this takes place naturally when certain glasses weather and oxidise.
- (2) The building up of a film on the glass by chemical methods.
- (3) The building up of a film on the glass by the evaporation of a mineral of the correct refractive index in a very high vacuum.

Films so hard that they can be put on the outside surfaces of lenses and can be cleaned by all normal methods are produced by the evaporation process. Fig. 6 shows one type of apparatus used.

The optics to be coated are put into a bell jar, and a pumping system started. Whilst the pumping system is working, a high voltage discharge is passed to clean out the system and there is also a heating arrangement which is brought into use. The necessary degree of vacuum having been obtained (about one ten-thousandth of a mm. of mercury), a small metal crucible is heated by a low tension current so as to volatilise the mineral it contains. The mineral evaporates and condenses on the cool parts of the bell jar, including the optics. The lenses are carefully watched to see that evaporation is stopped with the film at just the correct thickness, which is when the film is a plum purple in colour by reflected light. The pumps are allowed to cool and the lenses are removed, the whole process taking about an hour and a half.

The following transmission figures will clearly indicate the benefit of 'blooming' :—

				<i>Axial Transmission</i>	
				<i>Uncoated</i>	<i>Coated</i>
3½ in.	"Rosskote"	Lens (6 elements)	... ..	72%	91.5%
4½ in.	"Rosskote"	Lens (4 elements)	... ..	79%	95%

BIBLIOGRAPHY

J. Walsh. *Photometry*.

Prof. Martin. *An Introduction to Applied Physics*, Vol. II.

DISCUSSION

Mr. R. PULMAN : I rather felt that the figures given for light transmission were of the past ; first of all, they related to the condenser system, secondly they did not cover the surface treatment of the projection lenses.

THE AUTHOR : The figures I gave were for an unbloomed lens. I did that intentionally, to show up the way in which surface treating has tended to give increased efficiency. In the same way, in the condenser system, I gave the transmission at about 75%. In a condenser system, you have four air-to-glass surfaces, and transmission will be of the order of 75%, because not only do you have the losses by reflection, but there is the light which is absorbed in the considerable thickness of the condensers. In the case of a mirror arc, it is difficult to say the actual transmission ; I should think it is about 85%.

Mr. R. H. CRICKS : There are three directions in which the efficiency of our

projection system could be improved. The first is in the arc, the second the gate spot, and the third the screen. Mr. Anstis has indicated a loss of 50% in the gate spot ; this represents not only waste of light, but, as we all know, unwanted heat on the gate. Bausch and Lomb made a big step forward in their cylindrical condenser, which produced an oval spot of light. Is it not possible to produce a rectangular spot of light by the use of a prismatic condenser system ?

THE AUTHOR : I think Bausch and Lomb have quite an achievement in their Cinephor condenser, which gives an oval spot of light. With mirrors it is a very difficult thing to produce this effect. Experiments have been carried out with cylindrical lenses in the cone of light from the mirror, but one of the troubles in introducing further lens elements into that cone of light is the absorption of the lenses, which tends to compensate for the extra effect you get from pushing a little more light

into the gate aperture. I think, however, that the advent of blooming, which gives a better prospect of increased transmission, gives us a better possibility of doing something on those lines.

Mr. L. KNOPP: May I ask whether it is not misleading to introduce a term for magnification in the author's formula?

My second question is: If one obtains a 180° phase displacement with a monochromatic light of apple-green colour due to the characteristics of the bloomed surface of the lens, would not one experience a colour distortion when projecting other colours—as with a colour picture? In other words, if one obtains an optimum efficiency with yellow-green, must not one of necessity get a decreased efficiency with other colours and with the maximum inefficiency at the blue-red ends of the spectrum?

THE AUTHOR: To answer the last question first: you certainly do get a colour distortion, but the amount is so small as to be inappreciable. In surface treating, it is not possible to achieve the theoretical result of getting no reflection at all from your glass surface, because you cannot obtain the optimum conditions of having the film of correct thickness and of correct refractive index. The reason for not getting the film of correct refractive index is that there are only a few minerals available which have the right refractive index. For the apple-green one can reduce the reflectance on glasses of medium refractive index to approximately 0.75%. At the extreme red and extreme blue ends of the spectrum, the reflectance will be of the order of $1\frac{1}{2}\%$ so that it is only about 0.75% higher.

On the question of magnification of the crater, since the mirror images the positive crater in about the plane of the gate, the

conjugates of the mirror are of the order of $4\frac{1}{2}$ in. for the minor focus and 25 in. for the longer, which gives a magnification of six times, so that the size of the image of the crater in the gate for a 6 mm. crater would be 36 mm.

Mr. L. KNOPP: I quite appreciate that the image of the carbon crater is magnified, but this is not my point. We are interested in the intensity of the projected light and this intensity is decreased in direct proportion to the magnification.

THE AUTHOR: Definitely, it is reduced as the magnification.

Mr. R. PULMAN: We used to get very surprising results in theatres with the Zeiss-Ikon system. Was that system discontinued only because of the fact of the transmission factor being passed, or were there certain aberrations that caused trouble?

THE AUTHOR: The Zeiss-Ikon type of lamp is a good one, and was the first to use a collecting mirror which was parabolic; the arc crater being put at the focus of the 10 in. mirror, producing a parallel beam, free from spherical aberration. You then had a condenser lens 10 in. diameter and about 20 in. focus, so that the aperture of the condenser system was about $f/2$ —quite a good aperture. The collecting angle of the parabolic mirror was something of the order of 130° , which was a good pick-up angle. The main disadvantage of that system in comparison with the ellipsoidal system is, that you have spherical aberration in the large condenser lens. Therefore, you get some inefficiency. Also, you have the absorption of the condenser lens itself when comparing it with an ellipsoidal system. In the ellipsoidal system there is no spherical aberration produced, and there is no thick condenser between the mirror and the gate.

AMERICAN STANDARDS SPECIFICATIONS

The following newly issued American standards specifications have been received from the S.M.P.E., and may be consulted in the Library:

- Z22.5—16 mm. Silent Motion Picture Raw Stock.
- Z22.10—Emulsion Position for 16 mm. Silent Film.
- Z22.12—16 mm. Sound Motion Picture Raw Stock.
- Z22.16—Emulsion Position for 16 mm. Sound Film.
- Z22.17—8 mm. Motion Picture Raw Stock.
- Z22.22—8 mm. Silent Motion Picture Film.
- Z22.27—Method of determining Density of Motion Picture Films.

- Z22.35—16-tooth 35 mm. Sprockets.
- Z22.36—35 mm. Motion Picture Positive Raw Stock.
- Z22.55—35 mm. Sound Motion Picture Release Prints in 2000 ft. lengths.
- Z22.56—Nomenclature for Film used in Studios and Laboratories.
- Z22.58—Projection Aperture of 35 mm. Sound Motion Picture Projectors.
- Z22.59—Photographing Aperture of 35 mm. Sound Motion Picture Cameras.
- Z33.3.1—Safety Photographic Film.

POLYTECHNIC COURSES

The third of this year's series of B.K.S. Refresher Courses organised by the Polytechnic will be held on Monday evenings, starting on 19th April, from 6 to 8 p.m., at the Polytechnic, 309, Regent Street, W.1. The subject is "Photographic Optics and its applications to the Film Industry." The lecturer is Malcolm V. Hoare, B.Sc., M.B.K.S.

Students may enrol at or before 6 p.m. on the 19th April, or previously by post. The fee is £1 for the course of ten lectures, of which details are given below.

19th April.—The spectrum, spectra of light sources, colour temperature. Intensity, brightness. Candle-power, lumens, foot-candle, foot-lambert. Efficiency, lumens/watt.

26th April.—Spectral sensitivity of emulsions, wedge spectra. Colour and colour vision. Filters for contrast and control of colour temperatures. Filters in colour photography.

3rd May.—Pola screens. Exposure meters and photometers, measurement and brightness, intensity and contrast.

10th May.—Basic laws of geometrical optics. Inverse square law. Absorption, reflection, and refraction of light. Image formation of lenses.

24th May.—Gaussian optics. Focal length of thick lens. Conjugate foci and conjugate distances. Focusing movement and extension tubes. Supplementary lenses.

31st May.—Focal length and perspective. Brightness of image, $f/\text{nos.}$ Effect of enlargement.

7th June.—Depth of field and depth of focus in theory and practice.

14th June.—Errors of lenses, chromatic and spherical, image quality and resolution. Flare and its effect on contrast; coated lenses. Cleanliness. Lens hoods.

21st June.—Basic types of lens systems, symmetrical and unsymmetrical, telephoto and inverted telephoto. Zoom lenses. Testing a lens.

28th June.—Optical systems of cameras, finders, range-finders, spotlights, contact printers, projection printers and projectors.

ORDINARY MEETING

The Ordinary Meeting of the British Kinematograph Society, previously announced for April 14th, has been postponed until 6 p.m. on Wednesday, April 28th, at the G.B. Small Theatre, Film House, Wardour Street, W.1.

Corporate Members only are entitled to attend.

SUB-STANDARD FILM DIVISION

The Sub-standard Film Division is arranging on Wednesday, April 7th, at the Wellcome Foundation, Euston Rd., N.W.1, an exhibition of new sub-standard equipment. Details of equipment it is desired to demonstrate, all of which should have been developed since the previous exhibition held in May, 1947, should be submitted to the Secretary.

Exhibits will be on view at 5.30 p.m. The annual general meeting of the Division will take place at 6.30 p.m. and at 7.15 the customary meeting will open, taking the form of demonstrations and papers on

the equipment by the respective manufacturers.

Members of the R.P.S. Kinematograph Section are cordially invited to this meeting.

THEATRE DIVISION

The annual general meeting of the Theatre Division will be held at 10.30 a.m. on Sunday, March 21st (prior to the paper by Mr. A. F. Steel).

The Division is holding another discussion meeting on April 18th, and, following last year's procedure, invite members to submit questions of technical interest for discussion. Authors of questions may remain anonymous if they wish.

THE LIBRARY

At the meetings of the Society held on February 25th and March 10th, a short film publicising the work of the Library was projected. This film had been made and generously presented to the Society by Mr. Marcus Cooper, to whom thanks were conveyed.

TECHNICAL ABSTRACTS

Most of the periodicals here abstracted may be seen in the Society's Library

A LIGHT SOURCE OF CONSTANT INTENSITY FOR PHOTOGRAPHIC SENSITOMETRY.

A. Hautot, H. Sauvenier and R. Debot, *Science et Industries Photographiques*, Aug., 1947, p. 228.

The authors describe a circuit for supplying a lamp which minimises the effect of mains fluctuations by supplying less than 10% of the load from an accumulator. The circuit includes a Wheatstone bridge arrangement for checking the calibration during use. A routine of checking is described which will detect ageing of the lamp and enable its use to be continued.

M. V. H.

SYMPOSIUM ON THE EDUCATIONAL FILM.

W. A. Wittich, E. Albert, L. M. Franciso, and R. H. Ray, *J. Soc. Mot. Pic. Eng.*, Sept., 1947, p. 187.

From these four papers, it appears that the educational film in the United States is faced by the same handicaps as in this country: apathy of teachers, lack of projectors, and inadequacy of distribution facilities. The superiority of the sound film over silent is strongly argued. The last paper records some of the lessons learnt in producing training films.

R. H. C.

APPLICATIONS OF 16MM. MOTION PICTURE EQUIPMENT TO MEDICAL AND SCIENTIFIC NEEDS.

Mervin W. La Rue Senior, and Mervin W. La Rue Junior, *J. Soc. Mot. Pic. Eng.*, Sept., 1947, p. 241.

This paper describes in some detail two special equipments, a macroscopic kine camera unit, and a set-up of camera, microscope and lighting unit for kine-micrography.

The macroscopic unit, which is built around a magazine loading Filmo 16 mm. camera, is self-contained with lighting, and provision is made for focusing and framing the picture. The outfit for kinemicrography, comprising microscope, lamphouse and camera, is mounted on a girder base, and is sufficiently portable to be moved to the job when required.

W. B.

REDUCING SHOOTING TIME.

R. H. Cricks, *Kine. Weekly British Studio Section*, Oct. 2, 1947, p. xix.

With the object of increasing the production potentialities of British studios, a number of suggestions are made for reducing shooting time of films. The points relate to set construction, reduction of surplus footage, the relative merits of back-projection as against optical printing, and the desirability of making better use of stage space, as by doing as much work as possible off the floor.

AUTHOR'S ABSTRACT.

SPROCKETLESS DEVELOPING MACHINE.

W. Nauck, *Foto-Kino-Technik*, No. 2, 1947, p. 11.

The film feeding device in a developing machine consists of a rotated member of cruciform section, made of plastic; over each arm a strip of rubber is curved, which gives to the shrinkage of the film. An advantage is that the same machine can handle film of any gauge. The application of the system to a machine having an output of 10 to 14 metres per minute is described.

R. H. C.

PROPOSED STANDARD SPECIFICATIONS FOR FLUTTER OR WOW.

Report of S.M.P.E. Committee on Sound, *J. Soc. Mot. Pic. Eng.*, Aug., 1947, p. 147.

The specifications define the main characteristics of flutter and propose a standard index to be measured at 3000 c.p.s. Supplementary comments amplify the specifications and deal with the correlation of results obtained by other methods.

N. L.

PROPOSED STANDARD FOR 35 MM. FLUTTER TEST FILMS.

Report of S.M.P.E. Committee on Sound, *J. Soc. Mot. Pic. Eng.*, Aug., 1947, p. 160.

The specification defines the characteristics of a test film of low flutter content suitable for use in flutter measurement.

N. L.

MAGNETIC SOUND FOR 8 mm. PROJECTION.

Marvin Camras. *J. Soc. Mot. Pic. Eng.*, Oct., 1947, p. 348.

The article describes the addition of a magnetic sound track to sub-standard films. With 8 mm. film it is recommended to add the magnetic track in the space between the sprocket holes and the film edge. The adaptation of a conventional 8 mm. projector to magnetically recorded sound is described.

The author introduces a new value for sound recording, namely, product of the film speed multiplied by the track width, but it is quite clear that it can never be a measure of quality.

O. K. K.

AMATEUR PROJECTION EQUIPMENT FOR THE MASS MARKET.

P. H. Case, *J. Soc. Mot. Pic. Eng.*, Aug., 1947, p. 139.

Design aspects of low-priced 16 mm. projection equipment include elimination of framing, the use of an A.C. motor, a small lamp, capable of only an 18 in. picture, reasonably silent running, and provision for ease of manufacture and assembly.

R. H. C.

IGNITION MECHANISM OF RELAY TUBES WITH DIELECTRIC IGNITER.

N. Warmoltz, *Philips Technical Review*, Vol. 9, No. 4, p. 105.

The ignition method of applying a high frequency field between the wall of a mercury vapour discharge device and the meniscus of the mercury, can be improved by using quartz in the ignition zone instead of glass. This method is characterised by an exceedingly small demand of electrical input.

The report deals with a relay valve to be used as a switch in a stroboscope, but the accuracy in starting time and the small amount of power required would enable this scheme to be used in any power rectifier.

A. N.

A NEW TELEVISION PROJECTION SYSTEM.

W. E. Bradley and E. Traub, *Electronics*, Sept., 1947, p. 84.

In the new Philco Home Television Projection Receiver, the combination of a Schmidt optical system with a small projection tube, keystone projection and a directional viewing screen produces a picture 15ins. \times 20ins. of exceptional brightness and contrast.

The viewing screen is of the reflecting type, radiating equal flux within a 20° vertical angle and a 60° horizontal angle, giving a gain of 17.2 times over a perfectly diffusing surface. This distribution characteristic has been found to give the optimum results for use in the living room.

T. M. C. L.

COLORIMETRY IN TELEVISION.

W. H. Cherry, *BCA Review*, Sept., 1947, p. 427.

The first part of this paper deals with the value of various physical stimuli in exciting a sense of realism. The latter part of the paper is more relevant to the title, but does not appear to contribute any original subject matter. Two "erroneous ideas" are referred to, but not cleared up: first, that the choice of primaries with rectangular cut-off characteristics makes the use of more than three primaries unnecessary; secondly, that exact colour reproduction is possible by photographic masking, or its electrical equivalent.

L. C. J.

NEW RUSSIAN STEREOSCOPIC FILM

A. Abramov, *Soviet Art*, Sept. 19, 1947 (abstracted in *Film News from the Soviet Press*).

The second film produced for presentation by the Ivanoff system of stereoscopy is entitled "Machine 22-12." It is apparently not the equal technically of the first film, "Robinson Crusoe."

R. H. C.

THE COUNCIL

Meeting of 4th February, 1948

Present : Messrs. I. D. Wratten (*President*), W. M. Harcourt (*Vice-President*), E. Oram (*Hon. Secretary*), P. H. Bastie (*Hon. Treasurer*), C. Cabirol, R. B. Hartley, B. Honri, A. W. Watkins, A. G. D. West (*Past President*), R. Pulman (*representing Theatre Division*), H. S. Hind (*representing Sub-Standard Division*), G. Burgess (*representing Film Production Division*), R. H. Cricks (*Secretary*).

Divisional Committees.—The following Divisional Officers and Members of Committees were appointed :—

Theatre Division :	<i>Chairman</i>	...	Mr. S. B. SWINGLER
	<i>Committee</i>	...	Messrs. W. F. GARLING S. T. PERRY J. L. STABLEFORD
Sub-Standard Division :	<i>Chairman</i>	...	Mr. H. S. HIND
	<i>Committee</i>	...	Messrs. W. BUCKSTONE S. SCHOFIELD
Film Production Division :	<i>Chairman</i>	...	Mr. A. W. WATKINS
	<i>Committee</i>	...	Messrs. C. E. W. CROWHURST M. HARCOURT R. B. HARTLEY

Co-operation with A.F.I.T.E.C.—Discussions with Messrs. Didée and Vivié, Chairman and Secretary of the Association Française des Ingénieurs et Techniciens du Cinéma, were reported, with a view to a closer co-operation. Proposals were ratified for the exchange of journals, a monthly letter on technical and standardisation matters, and reciprocal arrangements whereby members of one society while in the country of the other would become temporary members of the latter. It had been further proposed that a small party of A.F.I.T.E.C. members should visit this country in May.

Co-operation with S.M.P.E.—A request was reported from the S.M.P.E. for copies of B.S. specifications. A standardisation project was discussed for submission to the S.M.P.E.

German Standards.—A meeting of the Photographic and Cinematograph Steering Committees of the B.S.I. was reported, which had been attended by Dr. Frank, Director of the Deutsche Normenausschuss ; it was hoped that the meeting would result in closer collaboration between the two bodies.

Film Mutilation Brochures.—Detailed proposals were reported for the publication by the B.K.S., in co-operation with the C.E.A. and the K.R.S., of brochures on the subject of film mutilation.

Library Committee.—Thanks were conveyed to Mr. Baynham Honri for the periodical stand which he had had made. A number of books were being sent to the library of the Newcastle Section. Mr. Marcus Cooper had kindly offered to prepare a short publicity film of the library.

Polytechnic Students.—The difficulty experienced by former students in the Polytechnic Course on Kinematography in obtaining employment was briefly considered.

Home Office Regulations.—It was reported that recommendations on the subject of the draft regulations under the Cinematograph Act were in preparation.

Theatre Division.—It was decided that, in the event of a Section being formed at Leeds, it should, as in the cases of the Manchester and Newcastle-on-Tyne Sections, be controlled by the Theatre Division Committee.

Film Production Division.—Tentative arrangements were reported for a visit to a studio, to be arranged on May 8th.

EXECUTIVE COMMITTEE

Meeting of 4th February, 1948

Present : Messrs. I. D. Wratten (*President*), W. M. Harcourt (*Vice-President*), E. Oram (*Hon. Secretary*), P. H. Bastie (*Hon. Treasurer*), R. H. Cricks (*Secretary*), Miss S. M. Barlow (*Assistant Secretary*).

Elections.—The following were elected :—

WILLIAM CHARLES SHEARD HARTE (Member), Rotherham Hippodrome, Ltd.
LEONARD FREDERICK STEWART (Associate).

BRIAN FREDERICK THAIN (Associate), Sound Services, Ltd.
 WILLIAM HENRY WILLIAMS (Member), Merton Park Studios.
 NORMAN CARLEY ALLIN (Associate), Film Producers Guild, Ltd.
 THOMAS CECIL THORN (Member), Pathéscope, Ltd.
 ROBERT LITTLETON HOULT (Associate), Pinewood Studios.
 SIDNEY OWEN RAWLING, D.Sc. (Member), Ilford, Ltd.
 HARRY KEBBELL BOURNE, M.Sc., M.I.E.E., F.R.P.S. (Member), Mole-Richardson (England), Ltd.

FRANK RAYMOND BENSTEAD (Student), Electro Methods.
 ALFRED BLAKE (Associate), Stoll Picture Theatre, Newcastle-on-Tyne.
 CECIL TAPSCOTT MASON (Member), Alliance Studios.
 GEOFFREY FRANK DICKINSON (Member), Ealing Studios.
 LEONARD CATHROW RUDKIN (Associate), Ealing Studios.
 ALBERT HALDRON WHEELER (Member), M.G.M. British Studios.
 IAN FRANCIS CAMERON (Student), Harrow Technical College.
 HANS VON FRAUNHOFER (Member), Anglo-American Colour Photographic Industries, Ltd.
 LESLIE FRANCIS (Member), Wallace Heaton, Ltd.
 MELVILLE LEONARD HYDE (Student), British Thomson-Houston Co., Ltd.
 ALFRED FREDERICK CARRINGTON (Associate), G.B.-Kalee, Ltd.
 VICTOR LOUIS ALEXANDER MARGUTTI (Member), Pinewood Studios.
 WALTER ROBERT STEVENS, B.Sc., A.M.I.E.E. (Member), G.E.C., Ltd.

Transfers.—The following Associates were transferred to Corporate Membership :—

ALBERT STANLEY PRATT, British Acoustic Films, Ltd.
 DEREK CECIL STEWART, Simpl, Ltd.
 MARY FIELD, M.A., G.B. Instructional, Ltd.
 GEORGE WILLIAM STANWIX, Kodak, Ltd.

The following Student was transferred to Associateship :—

GORDON SALMONS, R.E.M.E.

Resignations.—The following resignations were regretfully accepted :—

JOHN NEW (Member).	GEORGE A. JONES (Associate).
ANTHONY LEIR SHUFFREY (Associate).	KENNETH L. BARRETT (Associate).
COLIN SPURGE HARRIS, B.A. (Member).	REGINALD ARTHUR DANIELS (Associate).

Death.—The death of LEONARD J. P. KAMM was noted with regret.

Benevolent Fund.—It was agreed that any amounts offered for charitable purposes should be given to the Cinematograph Trade Benevolent Fund.

Divisional Chairman.—It was agreed to recommend that Chairmen of the Divisions should not be eligible for re-election after two years' service.

PERSONAL NEWS of MEMBERS

Members are urged to keep their fellow members conversant with their activities through the medium of British Kinematography.

C. G. HEYS HALLETT has been appointed managing director of Mole Richardson, Ltd., in place of—

C. G. LINDERMAN, who, although still a director of the company, is now resident in the United States.

J. P. SAYER, formerly Area Supervisor of Catlin's Mobile Cinemas, Ltd., is now Assistant Manager of the Capitol Cinema, Meanwood, Leeds.

H. C. STRINGER has been appointed to the boards of Charles H. Champion & Co., Ltd., and the Ship Carbon Co., Ltd., with which companies he has served for 25 years.

R. McVITIE WESTON has been elected chairman of the Scientific and Technical Group of the R.P.S.

ERIC WILLIAMS of Ealing Studios, has been working in Australia on "Eureka Stockade"; progress has been held up by bad weather.

I. D. WRATTEN has been elected Vice-President of the Royal Photographic Society.

JOHN WILMOT G. JACKSON

Died Nov. 4, 1947

After service in the R.N.A.S. and R.A.F. from 1917 to 1919, Mr. Jackson gained his B.Sc. in 1922, after which he was engaged in various research laboratories.

In 1944 he joined the Ship Carbon laboratories as a physicist.



He follows motion . . .

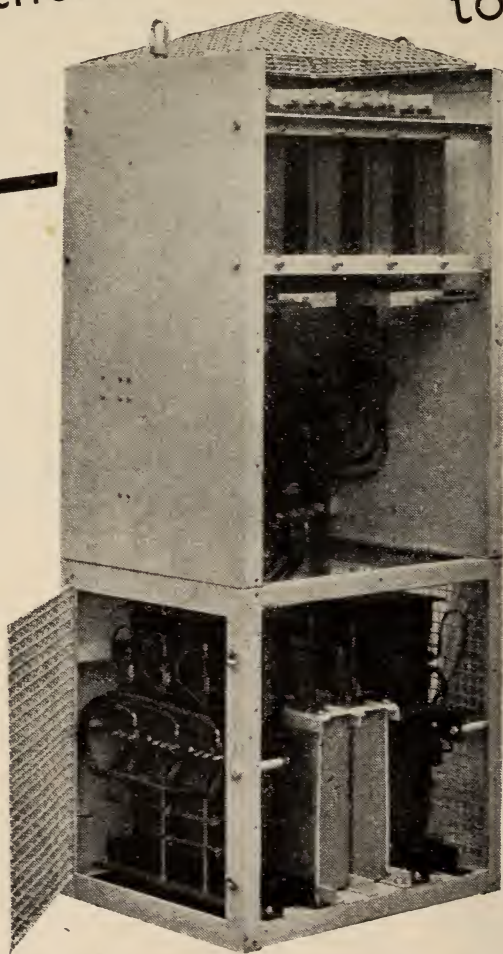
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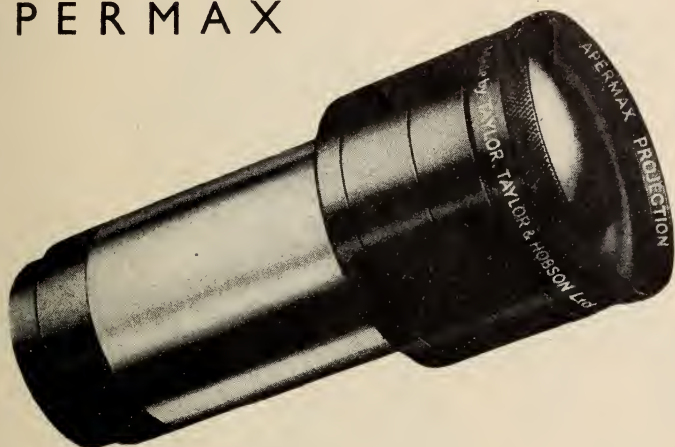
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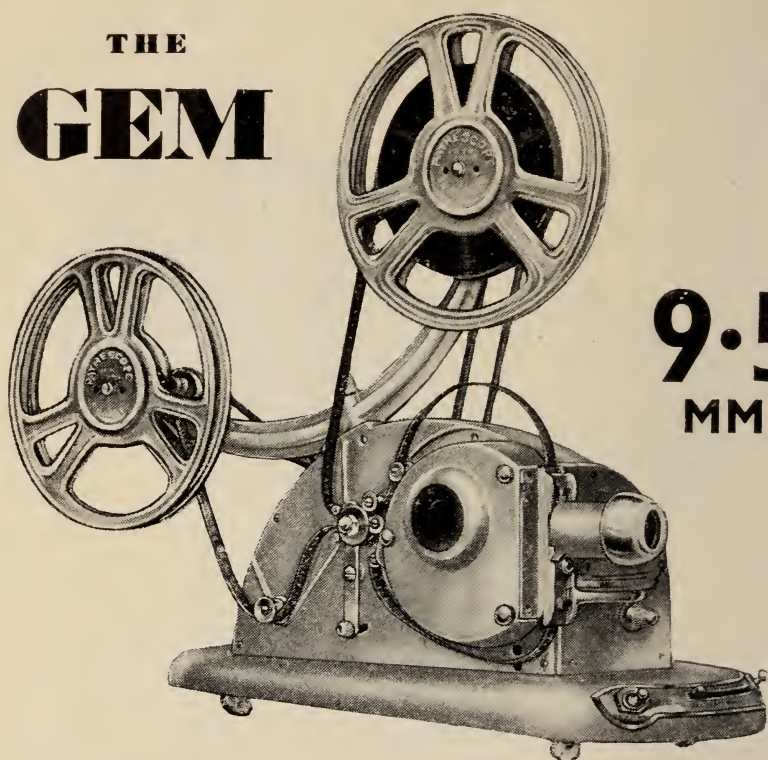
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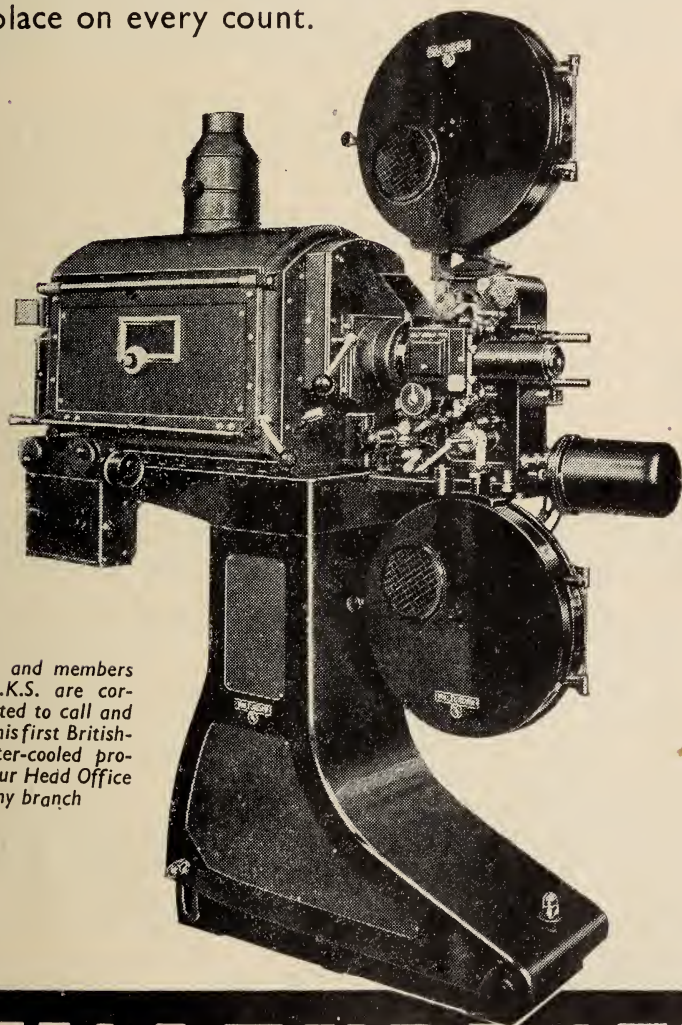
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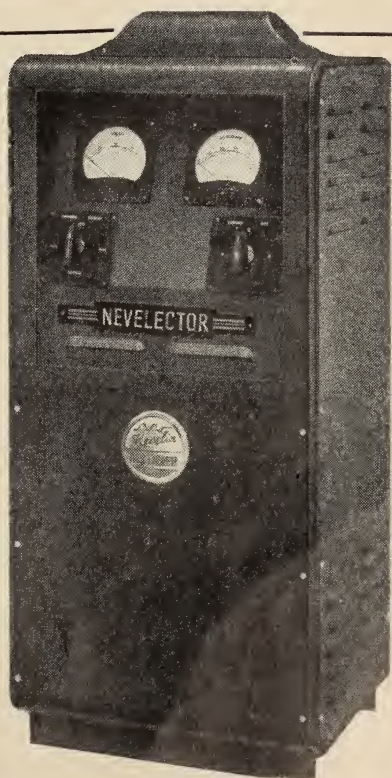
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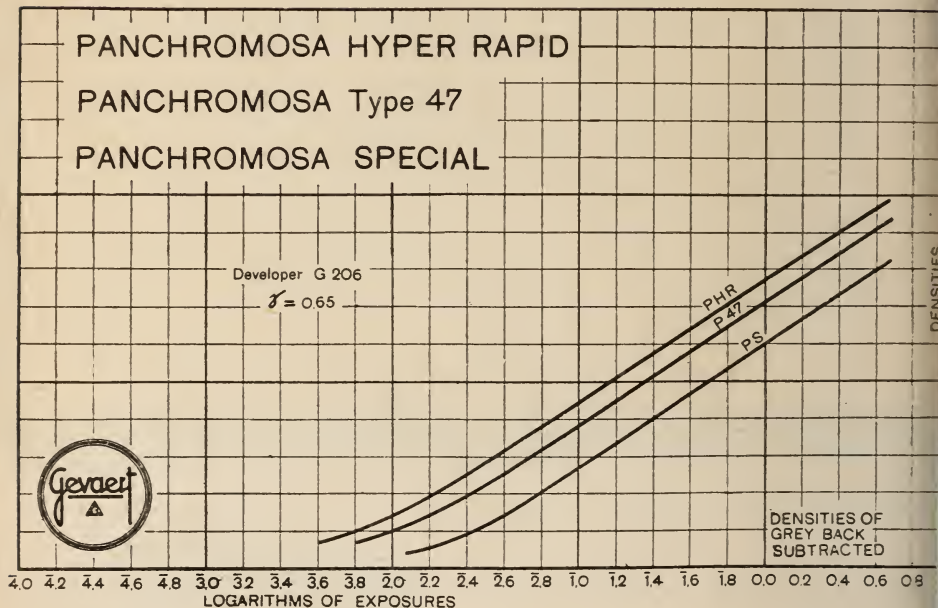
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BRITISH KINEMATOGRAPHY

The Journal of the British Kinematograph Society

VOLUME TWELVE, No. 4.

APRIL, 1948

METALS IN KINEMA AND RELATED EQUIPMENT

A. B. Everest, Ph.D., F.I.M.,* and F. Hudson, F.I.M.*

Read to the British Kinematograph Society on February 11th, 1948

THE authors of this paper are metallurgists and make no claim to an intimate knowledge of the kinema industry. In their work in dealing with problems in the application of high quality metals, however, they have found that the motion picture industry, like many other branches of modern engineering, depends in a large measure on the availability of suitable materials for its progress and development.

The field for review by the authors is exceedingly large, ranging from metals to resist corrosion in film manufacture and processing, to metals to resist high temperatures in arc lamp construction, or metals to match the contraction characteristics of glasses used in the construction of valves and tubes for sound amplification and television.

After a study of the relevant literature and interviews with some of the leading authorities in the kinema industry, the authors decided that the following items could most usefully be put forward for consideration and discussion :—

1. Current problems in film manufacture and processing.
2. Metallurgical problems in cameras and projectors.
3. Interesting metals for electronics and sound reproduction.
4. Miscellaneous items where special properties are required.

It should be emphasised that the authors have a particular interest in nickel and related alloys. Such alloys have provided the solution to many of the problems encountered in the kinema industry, and this is perhaps sufficient excuse for the rather wide reference to nickel in this paper. Non-metallic materials which find wide and successful use for many items of plant and equipment construction are, of course, outside the scope of this review.

I. FILM MANUFACTURE AND PROCESSING

The first requirement in the manufacture and handling of film is absolute cleanliness—"surgical cleanness" it has been called—in order to avoid contamination of the product and to ensure consistency in the behaviour of the film in exposure and processing. Corrosion-resisting materials are essential, since, in the first place, corrosion products in the form of rust, etc.,

*The Mond Nickel Company, Limited

are likely to deposit dirty particles in or on the film ; secondly, since corrosion frequently poisons the processing liquors, especially developers, whose activity is seriously inhibited by even traces of contaminating metals derived from corrosion ; and, thirdly, since no danger of breakdown or unreliability in the processing plant can be countenanced as a result of corrosion leading to failure of tanks or other components.

Corrosion problems can, of course, be avoided by the use of non-metallic materials, and in fact liberal use is made of wood, hard rubber, ebonite, plastics, etc., for many details in film handling and processing equipment. Some use of metal is, however, generally essential in the construction of the plant. The choice of alloy for a particular service is, of course, influenced by a number of other factors, including price. In addition to being corrosion-resistant, the metal must have reasonable workability, that is to say, it can readily be formed to the required shape by such operations as pressing or machining.

A large part of the metal construction is made from sheet. The sheet metal chosen should have a high degree of polish since this assists cleanliness. The mechanical properties of the sheet should also be good to provide robustness in the finished part. For fabrication the materials must also be readily weldable and give welds which are sound and corrosion-resistant. This depends not only on good welding practice and suitable welding rods, but also on the ability of the metal to resist deterioration by heat and other effects encountered during welding. The necessity for good welding properties is emphasised by the type of construction, for example, for tanks in which smooth internal surfaces are required with absence of sharp corners, crevices and other points where dirt might lodge.

A review of current practice shows that the metals commonly used for film manufacture and processing are nickel, austenitic stainless steel, Monel and Inconel. These all fulfil for the greater part the requirements set out above, but the ultimate choice clearly depends on the conditions involved, cost and availability.

Pure Nickel. Pure nickel finds wide application in film manufacture as referred to below, and is used to some extent for processing. Nickel is used mainly in sheet form or as electroplated nickel surfaces. It is used extensively in the manufacture of film base. For processing equipment, plated metals or alternatively clad materials—that is, composite metals in which one face is, say, of nickel and the backing is steel—are not favoured due to the danger of breakdown at joints, or due to possible imperfections in plated surfaces. Nickel is available in the form of castings for pumps and valves and as pipe for handling pure water and certain chemicals, especially of the alkaline type.

Austenitic Stainless Steel. A number of types of stainless steel are referred to in the literature as suitable for the production of film processing equipment. These are always of the basic 18% chromium 8% nickel austenitic type and allied compositions. Generally speaking, the most satisfactory results seem to have been obtained with steel of the 16–18 chromium 8–14 nickel type, with additions of about 3% of molybdenum. Variations used successfully include alloys with higher contents of nickel and chromium, but the presence of molybdenum is generally considered desirable, since it gives added corrosion-resistance. Normal titanium- and columbium-bearing qualities are used for welded fabrication.

Monel is an alloy consisting roughly of two parts nickel and one part copper. It is essentially a clean metal, and combines good corrosion-resistance with the desired mechanical properties, good weldability, and the capability of taking a good finish. It is available in all the usual forms, including tubes and coils. As referred to below, Monel suffers from the disadvantage that it is not suitable for contact with fixing solutions.

Fig. 1. Pure Nickel Wheel for Formation of Film Base.



Inconel is a high nickel-chromium-iron alloy with excellent corrosion-resistance and mechanical properties. It has been found the best of the alloys selected for some of the most exacting conditions in film manufacture and handling. It is reported to be favoured for handling emulsions and in processing equipment, since polished surfaces of *Inconel* do not readily wet, and this is considered a useful attribute in maintaining the general cleanliness of equipment. *Inconel* is readily fabricated, but like austenitic stainless steel, is somewhat harder than *Monel*. For example, some difficulty has been found in obtaining it in the form of coils for heating and cooling stock solutions. It has also presented in the past more difficulty with welding, but this last trouble has been largely overcome with recent developments in new welding rods and techniques.

Electrolytic Corrosion

An important principle which must not be overlooked in the construction of processing plant is that, whereas individual metals as, for example, one grade of stainless steel or *Monel*, may be equally suitable, there is always some possibility of electrolytic corrosion taking place if the two are employed in proximity. Usually troubles with electrolytic corrosion are not great between the highly corrosion-resistant alloys such as *Monel*, *Inconel*, stainless steel or nickel, but even slight corrosion might prove a problem. It must also be remembered that with any of these metals serious troubles might arise from pipe connections, or at any other locations where inadvertently the metal might be connected to commoner metals such as brass or iron.

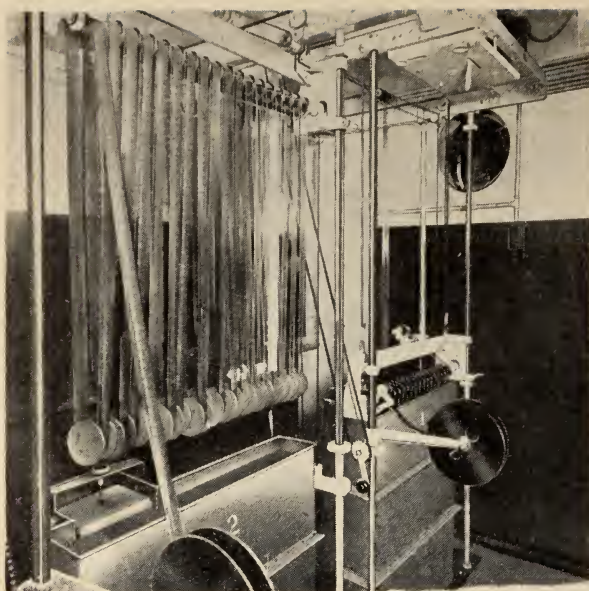
II. FILM BASE MANUFACTURE

Film base is manufactured in bulk by a few large-scale makers, and little information is available on production problems. The need for cleanliness in the production of film base is paramount, and it is interesting to record that pure nickel or nickel-plating is used extensively. (Fig. 1.) Some of the components of the machinery used are of considerable size and weight. Cast iron is employed as, for example, for some of the large wheels on which the base is formed. High quality alloy cast iron has been adopted in order to ensure maximum soundness and density throughout and also to provide a satisfactory foundation for the nickel-plated surfaces.

Application of the Emulsion

Materials used in handling emulsions for the sensitisation of films must be highly resistant to many chemicals, including salts of the nitrate or bromide types. Up to ten or twelve years ago the plant for preparing and handling the emulsions was manufactured largely of glass or other ceramic materials, and metal parts were made either in silver or nickel. As new metals became available, both *Inconel* and stainless steel were adopted. Nickel seems to have been preferred for plant for the purification and preparation of gelatine, although some users favoured *Inconel* for parts in contact with the emulsion.

In the last ten or twelve years the situation has changed somewhat, in that



Courtesy of W. Vinten, Ltd.

Fig. 2. Film Processing Units constructed mainly from Austenitic Stainless Steel.

stainless steels. Both materials are favoured by individual makers, as they are found to be equally adaptable to the production of tanks, etc., by welding up sections previously shaped so as to avoid crevices and corners, in the finished structure.

III. FILM PROCESSING

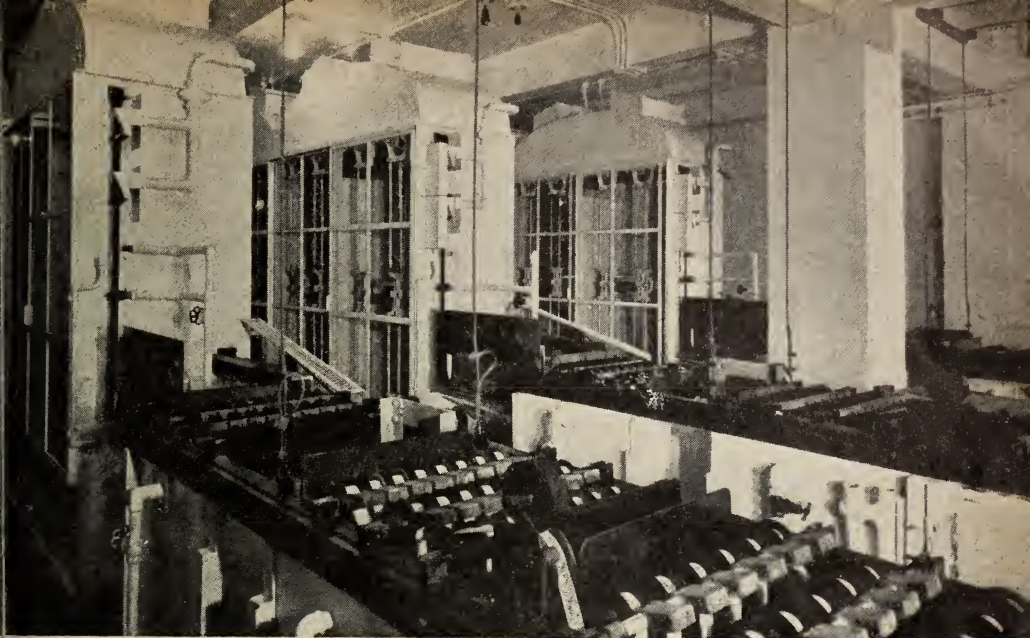
Materials for the construction of film processing equipment have been reviewed by Crabtree, Matthews and Muehler in an excellent paper.¹ Discussions with British manufacturers of plant in this field show that the principles laid down by these authors are widely adopted in practice.

Film Developing

Reference has already been made to the necessity of avoiding corrosion which might lead to contamination of developers. Film fogging is liable to result from trace elements, particularly tin and copper. Contamination by iron has a less serious effect in inhibiting the action of the developer, but iron corrosion generally leads to dirt in the film.

Wide experience shows that Monel, nickel, Inconel or stainless steel are all satisfactory in contact with developers. Some plant designers favour Monel due to its good working and fabricating properties, and the fact that it has especially good bearing properties with the non-metallic materials commonly used for spools, etc. Stainless steel and Inconel² also find wide application for metal parts in contact with developers, both here and in the U.S.A.

In the largest processing units non-metallic materials such as wood, etc., are used for tanks and structural members of the racks carrying the film spools. As already mentioned, spools are generally in non-metallic material, and sprockets also are usually non-metallic, but incorporating a metal ring shaped to provide the sprocket teeth. In one typical plant examined Monel is employed for all the shafting, tie rods, bolts and general structural details of the developing tanks. (Fig. 3.) In this case new tanks to be built will be fitted with Monel frames built up from angles for carrying the spools. Monel is also used for bolts, screws, etc., employed in the construction of the tank



Courtesy of G. Humphries & Co., Ltd.

Fig. 3. Commercial Film Processing Plant.

itself and of the spool set-up. In this particular processing unit the accent is on Monel for all the metal details in contact with developer.

Molybdenum-containing stainless steel is favoured by other makers and appears to be satisfactory, though possibly it may present a slightly greater fabrication difficulty in certain directions. Once again, it should be emphasised, however, that if Monel or stainless steel is chosen for the main components then the same material should be used throughout in the construction of the developing plant.

Spray Development

An integral part of the developer tank is the piping through which developer is delivered. In the normal type of equipment this involves the use of Monel pipe and connections, with Monel spray pipes for delivering the developer to the surface of the films. Interest is now being taken in equipment in which the spray method of applying the developer is employed. In this, the film is not immersed in the developer solution, but a continuous supply of developer is flowed on to the surface of the film through a nozzle, and the film is processed by the passage of the developer over its surface. In one plant recently discussed, stainless steel of the F.D.P. quality is used for the delivery nozzles. This method of development presents certain problems, however, in that the tanks must be closed in order to prevent the escape of spray and to minimise circulation of air, with consequent deterioration of the developer. The corrosive conditions encountered in this type of processing are severe, and Monel or stainless steel is used throughout for the construction of the plant.

Corrosion by spray or by vapours adjacent to developing tanks makes it necessary to ensure freedom from corrosion of such ancillary plant as gearing used for driving the machine. Hard grades of Monel suitable for gears are available, giving greater wear-resistance than the standard alloy.

Tanks and Piping

The general principles involved in the selection of materials for the construction of film processing machines apply to the auxiliary plant for the storage, temperature control, filtering and pumping of the developer. Monel is used extensively for filter bodies and plates, and is also employed for the

pressure pumps used for driving the developer through the filters in clearing it for use. In this section of the plant stainless alloy piping may be employed, but it has been noted in many examples that non-metallic materials or iron or steel coated with non-metallic substances are usual. Storage of developer will generally be in wooden tanks, but temperature control is effected by means of heating coils, for which Monel is favoured, owing to the ease with which it can be provided in suitable form. The low pressure circulating pumps for delivering the developer to the processing machine are generally in non-metallic materials, in which case stainless steel or Monel is used for the shafting. Metallic construction for the circulating pumps is satisfactory, and Inconel, stainless steel, Monel and even corrosion-resisting cast iron have been adopted for the pump bodies, impellers, shafts, etc. Monel or stainless steel is used for buckets, mixing tanks and other details of equipment in handling the developer.

Corrosion-resisting cast iron is of interest for auxiliary plant, and special reference should be made to it for pumps, valves, drain pipes, etc., where something better than ordinary cast iron is required, but the high degree of corrosion-resistance of the more expensive stainless alloys is not necessary. Such an iron is "Ni-Resist" which, by virtue of the inclusion of about 15% of nickel, 6% of copper and 2% of chromium, has an austenitic matrix. This means to say that Ni-Resist bears to ordinary cast iron the same relationship as does chromium-nickel stainless steel to ordinary steel. Against alkaline solutions and many weak acids, Ni-Resist has a corrosion-resistance often 100 to 500 times that of ordinary cast iron. Ni-Resist drain pipes are, for instance, employed in the Mond Nickel Company's own laboratory. It will be noted that these pipes are suspended from the ceiling and are used under conditions where a long-life material is required with greater strength and robustness than is available in non-metallic materials.

The availability of Ni-Resist should be borne in mind for all locations where iron castings are required with improved corrosion-resistance, coupled with toughness and strength. Ni-Resist is in a different class from the well-known silicon-iron, in that it is a soft machinable metal, whereas the latter is hard and brittle; it has not, however, the same degree of resistance to strong acids.

Washing Tanks

Materials and design used for washing tanks are similar to those for developer units and the same construction is usually applied throughout, particularly as the washing tank is incorporated in the developing machine.

Fixing

The general construction of the fixing end of the processing machine is, of course, similar to that of the developing end. There is, however, one vital difference in that Monel is considered unsuitable for contact with fixing solutions. Little attack is noted with Monel in contact with fresh hypo solutions.² When, however, the hypo solution is in use and contains a certain amount of dissolved silver salts, then precipitation of silver takes place on the surface of the Monel. This precipitation is always accompanied by some corrosion. Tests carried out in the U.S.A. indicate that Inconel is the only material which is quite unaffected by spent fixing solutions. This conclusion was reached after three years' exhaustive tests. Molybdenum-containing stainless steel has, however, also been found to be good by many builders of processing equipment and is, in fact, extensively employed for the construction of details at the fixing end of the machine. Details of construction are similar to those given above for the developing equipment, except that for Monel, Inconel or stainless steel must be substituted. The latter materials are used for spindles, pipes, valves, structural members, etc.

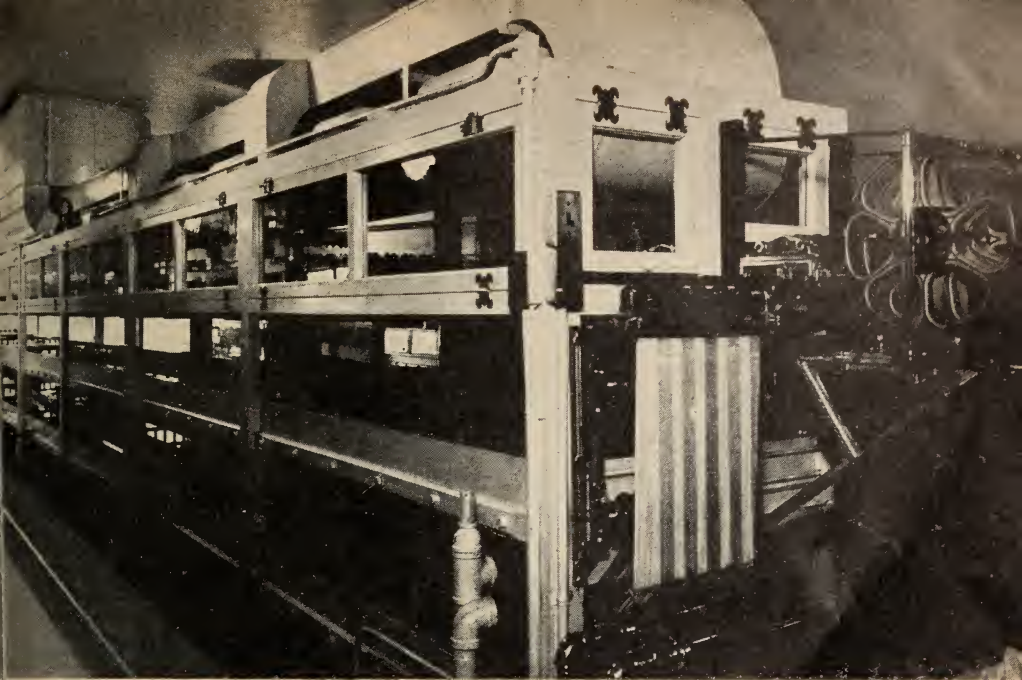


Fig. 4. American Film Processing Unit showing Inconel Air Ducts.

Acid fixing baths may evolve a certain amount of moist SO_2 vapour. Such vapour is highly corrosive and tends to attack the commoner metals. It is essential, therefore, when covers or other parts adjacent to the fixing tanks are used, that they should be constructed of corrosion-resisting alloys. Molybdenum 18/8 stainless steel has been found satisfactory under these conditions and is recommended.

In the fixing solution storage tanks some difficulties have been experienced in selecting a suitable metal for heating coils. In this connection, coils of Inconel tubing have not been readily available, nor is it easy to fabricate such coils from stainless steel. A solution of the problem has been found in the use of straight lengths of Inconel tubing with suitable rubber connections at the ends, thus building up a grid which is used as the water heater or cooler for the fixing solution.

Silver Recovery

An important item in a large film processing laboratory is the recovery of silver from the fixing solution and the reconstitution of the solution for recirculation. Silver recovery may be effected by electrolytic methods, and successful plants have been in operation for some time using stainless steel or Inconel sheet cathodes. Experience has shown that both these metals are eminently satisfactory, as they will operate for years without any appreciable attack, and the silver deposited is non-adherent and can readily be recovered merely by washing it off. Stainless steel has also been used for the anodes of silver recovery vats.

Film Drying and Winding

Washing of the film after fixing is carried out in a tank, the construction of which is on lines similar to those used for the fixing and developing plants. On leaving the washing tank the film passes suction heads which remove the bulk of the moisture adhering to its surface. Corrosion and wear of the metal parts coming in contact with the film must be avoided. Monel is used by at least some makers for the construction of suction heads.

Film drying and winding call for no special comment. Cleanliness is essential, and Inconel is used in the U.S.A. for vapour ducts over processing and drying machines so that complete freedom from corrosion shall be secured with absence of any danger of dirt and dust being found in the atmosphere as a result of attack. (Fig. 4.)

IV. PRINTING AND PROCESSING OF POSITIVES

The construction of printing machines does not call for special comment. Provided good quality materials are chosen for the construction of machines little trouble should be experienced. Clearly corrosion is not likely to occur, provided the machine is kept in conditioned atmospheres, but in the interests of cleanliness, plated or stainless materials should be used for parts likely to be touched by the human hand.

Some reports have been received that wear may become serious in printing machines, but, generally speaking, wear of sprockets, gates, etc., is relatively light. The general problem of wear of such parts will be dealt with later in connection with cameras and projectors.

The processing of positives is, of course, carried out in the same type of equipment as for negatives. The only difference is that, owing to the lower sensitivity of positive film, a slightly more alkaline type of developer is normally employed. This does not, however, affect the consideration of materials already discussed in the processing of negatives. Cleanliness is, of course, again paramount in all other items for handling the film. No special point arises in connection with winders, but for inspection tables, splicing machines and the like, Monel or stainless steel is usually employed to eliminate dirt and possible scratching of the film due to rough spots resulting from corrosion.

V. CAMERAS

The modern professional 35 mm. motion picture camera has to operate under a variety of conditions. To-day it may be used in the tropics, whilst to-morrow it may be flying over arctic wastes. Considerable attention must,

TABLE I
COMPOSITION AND MECHANICAL PROPERTIES
OF HIGH STRENGTH CAST ALUMINIUM ALLOYS

D.T.D. 313 and 309

Copper	...	per cent....	...	...	0.8	to 2.0
Nickel	...	„ „	...	...	0.5	to 1.5
Magnesium	...	„ „	...	...	0.3	to 0.8
Iron	...	„ „	...	...	0.8	to 1.4
Silicon	...	„ „	...	...	2.0	to 3.0
Titanium	...	„ „	...	...	0.05	to 0.3
Aluminium	...	„ „	...	...	Remainder	

Mechanical Properties	Sand Cast		Die Cast	
	as cast	artifici- ally aged	as cast	artifici- ally aged
Proof stress (0.1%) tons/sq. in. ...	5	18	7	19
Maximum stress tons/sq. in. ...	10	19	13	22
Elongation % in 2 in. ...	2	1	5	3
Brinell Hardness No. ...	70	100	75	110

therefore, be given to ensure that whilst the camera is of robust construction, it remains readily transportable, and its mechanism, as well as being able to withstand mechanical wear, must also resist some degree of corrosion from climatic conditions and from the film itself. In connection with this latter point, it is not always appreciated that green film nearly always contains sufficient free acid to corrode metal parts coming into contact with it. The development of the high-speed camera within recent years has introduced additional problems which have been overcome by the correct use of those metals and alloys commercially available to-day.

So far as structural parts of the camera are concerned, *e.g.*, body, lens turrets, film magazines, etc., extensive use is made of one or other of the special high strength cast aluminium alloys, in the R.R. and Ceralumin range, so widely used on aircraft. The composition and properties of a typical alloy in this group are shown in Table I, and it is worth while noting the remarkable increase in mechanical properties which can be obtained after suitable heat-treatment. The latest Vinten 35 mm. H.S. 300 high-speed camera incorporates aluminium alloy castings of similar type.

Monel or S80 stainless steel (18% chromium, 2% nickel) are widely used for sprockets, gates, film tracks, guide rollers, etc., in view of the good resistance of these alloys to wear and corrosion.

Static Discharges

In high speed cameras static charges of electricity of considerable magnitude are generated by the friction of the film as it travels through the mechanism. Such discharges are clearly visible in a darkened room, appearing as a continuous flame through the gate between top and bottom film tracks. It has been found that S80 stainless steel gates and tracks are pitted where such discharges occur, but this attack is eliminated by the use of "K" or ordinary Monel for the parts in question, particularly so far as high-speed cameras are concerned.

In the U.S.A. "K" Monel is giving very satisfactory service for film gates, tracks and guides on cameras, and has proved to have better resistance to

TABLE II
COMPOSITION AND MECHANICAL PROPERTIES OF "K" MONEL

Nickel	...	per cent.	...	...	66.00
Copper	...	"	"	...	29.00
Aluminium	...	"	"	...	2.75
Silicon	...	"	"	...	0.25
Manganese	...	"	"	...	0.40
Iron	...	"	"	...	0.90
Carbon	...	"	"	...	0.15

Mechanical Properties	Hot rolled or forged		Cold worked and heat treated
	Softened	Heat treated	
Yield point (tons/sq. in.) ...	19	43	60
Maximum stress (tons/sq. in.) ...	39	60	72
Elongation % in 2 in. ...	35	20	12
Izod Impact. ft. lb. ...	100	40	25
Brinell Hardness No. ...	140	270	320

wear than stainless steel. Under trial test, about one million feet of film passed over the "K" Monel parts without any perceptible wear taking place. Table II outlines the composition and mechanical properties of "K" Monel, from which it will be observed that as well as having a good resistance to corrosion its strength and hardness are comparable with those of heat-treated alloy steel.

VI. STUDIO LIGHTING

Following the more extended use of colour photography, the need has arisen for improvements in the lighting employed in film studios, both as regards intensity and light values, which should approximate to natural daylight. As a result, considerable developments have taken place during recent years in the design and construction of the arc spot lamps used for this purpose.

In the modern high intensity arc lamp the metal contact brush used for holding and guiding the positive carbon must be highly resistant to heat and corrosion. Scaling, burning, pitting or distortion of the brush seriously interferes with the operation of the lamp in view of the fact that the carbon is mechanically fed through the brush. It is, therefore, essential that the reamed hole gripping the carbon remains smooth and to size in the bore. Copper-base alloys as used in the older type of lamps had to receive attention at frequent intervals and their life was extremely short. To-day, the positive carbon brushes are generally made from either nickel or Monel castings.

Fig. 5 illustrates the Ultra-High-Intensity Arc Spot Lamp made by Messrs. Mole-Richardson (England), Ltd., in which the brush used for holding and guiding the positive carbon is constructed from nickel castings.

It might be of interest to mention that during the war similar materials were satisfactorily employed for electrode holders on the most powerful of all spot lights, namely searchlights.

VII. PROJECTORS

The standard 35 mm. professional cinematograph projector is undoubtedly a fine example of precision engineering, and it is interesting to note that so far as latest developments are concerned, British manufacturers are amongst the foremost in the world. The magnification of between 300 and 400 times linear from film to screen, coupled with the fact that the mechanism is required to run quietly at fairly high speed for long periods with minimum wear, demands not only extremely accurate production, but also the use of suitable constructional materials.

One of the latest British projectors, which has been much admired in the U.S.A., is the Gaumont-Kalee "21." In this projector all the important gear spindles are made from 3% nickel case-hardened steel and run in high grade nickel-chromium alloy cast iron plain bearing bushes to ensure long life. For parts of more complicated design, a suitably heat-treated high tensile nickel-chromium (nickel 3%, chromium 0.75%) or nickel-chromium-molybdenum (nickel 1.5%, chromium 1%, molybdenum 0.25%) alloy steel is employed.

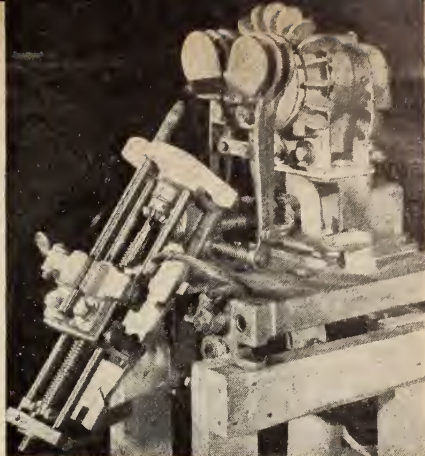
Intermittent Components

The most important part of the mechanism is probably the Geneva motion which stops and starts the film twenty-four times per second. The Maltese cross, cross shaft and certain gears are made in either one or other of the nickel-chromium or nickel-chromium-molybdenum alloy steels just mentioned, whilst the cam which operates the cross is in 3% nickel case-hardened steel. The Geneva motion and driving mechanism is housed in a rectangular nickel alloy cast iron box. Lubrication is effected by means of

a pump from an oil sump inside this box, and there must be no porosity in this casting, which is machined all over, as any oil leakage would prove damaging to the film and sound system. Alloy cast iron, containing around 1.5% nickel, is used as it has been found to meet service requirements as regards freedom from porosity.

In keeping with the best practice, film sprockets, guide rollers and gates are made from case-hardened steel. Under certain conditions there appears to be a need for such parts to have a greater resistance to corrosion

in addition to high hardness, and it might be pointed out that it is now possible to harden austenitic stainless steel of the 18/8 type by means of the nitrogen hardening process. Stainless steel parts treated in this way are not so liable to the distortion common to normal heat-treatment methods and the hardness values obtained are at least equal to those of case-hardened steels.



Courtesy of B. Rhodes & Son, Ltd., and Mole-Richardson (England), Ltd.

Fig. 5. Mechanism of High Intensity Arc Spot Lamp.

Projection Arc Lamps

The chief requirement in the modern projector arc lamp is the use of metals which will withstand distortion, scaling and possibly the corrosive action of metallic salts common to the high intensity arc. This particularly applies to electrode holders and supports. Furthermore, when magnetic control is employed, metallic parts in proximity to the arc must be non-magnetic. Alloys such as Inconel, austenitic stainless steel, Monel and aluminium bronze to B.S.1073 meet this requirement, and are eminently suitable for the parts in question. Inconel is particularly satisfactory for the construction of flame traps and shields.

To-day a considerable number of projector components, such as height adjusting screws, spool box and door hinges, control knobs, roller brackets, gate frame, oil pipes, etc., are bright nickel-plated in order to obtain an attractive appearance and to afford protection against discoloration and rusting. It cannot, however, be too strongly emphasised that plating should not be used on parts subject to mechanical wear or which actually touch the film.

Sub-standard Equipment

So far as sub-standard film gauges are concerned, there is no doubt that the 16 mm. projector is being increasingly used for professional purposes. Pre-war sub-standard projectors, as produced for the amateur, were not constructed for really hard use. In many instances, sprockets and film gates were simply made from plated brass or bronze, with the result that wear of both film and machine was rapid. The use of stainless steel or "K" Monel for such parts is recommended and is, in fact, being adopted by manufacturers in their new productions.

VIII. PROJECTION SCREENS

Metallurgy is assuming increasing importance in connection with projection screens. For many years aluminium paint has been widely used for surfacing either plywood or canvas. For fixed screens it is possible to use a metallic surface such as, for example, the Stableford screen, which consists of over-

lapping sheets of thin aluminium with vertical slits to allow for sound transmission. When metal screens are employed the loud speakers should be so placed as to avoid resonance which is liable to occur if the speakers are placed behind the screen. The surface should be shot-blasted or given a suitable chemical finish such as by pickling. The use of an anodised surface is not recommended. In a wide kinema where some of the audience see the screen from an oblique angle, a coarse screen surface, such as that given by shot-blasting, is generally preferable, but if the screen is at the end of a long hall, the surface provided by a chemical finish will probably give a brighter picture.

Shot-blasted stainless steel (18/8 type) has been employed for kinema screens.

IX. SOUND RECORDING AND REPRODUCTION

Up to the present, optical methods of sound recording and reproduction have been standard. From the metallurgical point of view these methods do not call for any special comment. Since the war, considerable attention has been given, however, to magnetic methods, and a great deal of development work has been carried out both in this country and abroad on such methods.

Magnetic Recording

As compared with the optical method, magnetic recording offers special advantages, particularly with regard to fidelity of reproduction and to simplification of editing. The method is also flexible and on this account appeals to kinema technicians. Magnetic recording of speech is, of course, old. It was used well before the last war for the reproduction of broadcast programmes and the like. The system adopted generally depended (as in the Blattnerphone) on the use of a carbon steel or tungsten steel tape.

During the war there was considerable development in speech recording. In Germany, for example, the Magnetophone was widely used for service requirements. The magnetic element in this case consisted of a plastic tape impregnated with magnetic iron oxide. The latter material was effective in that it possessed the desired magnetic properties and could be obtained in an extremely fine grain size. It has been stated that a fine grain, generally less than 1 micron, is desirable in order to eliminate background noise without the necessity of excessive record speed and to provide fidelity of reproduction.

Parallel with this, development work was carried out in the United States using extremely fine wires of magnetic material. An instrument suitable for service purposes was developed in which the magnetic element consisted of a fine wire made from hard drawn stainless steel of the 18/8 type. This alloy, as is well known, is normally non-magnetic, but develops suitable properties for magnetic reproduction when subjected to severe cold work as in hard drawing. Stainless steel is much superior to the older type carbon steel or tungsten steel wires or tapes on account of its high degree of corrosion-resistance. Any corrosion, rust spotting, etc., is disastrous in that it results in severe background noise. Magnetic alloys of copper, nickel, and iron have also been extensively used as wire records.

Recording on Plastic Tape

Current developments are proceeding in many countries, using either plastic or paper tape carrying magnetic material in powder form, either impregnated with the plastic or coated on to the surface of the tape. Alternatively, development is proceeding with the use of stainless metallic wires as used during the war.

Perhaps the most promising development from the kinema point of view is

the use of paper or plastic base tapes incorporated or coated with magnetic material. It would, however, be ideal if the magnetic element could be incorporated with the film, and it is understood that future development is possible in which a magnetic sound track is combined or incorporated in the film. Work is proceeding with the use of magnetic iron oxide on account of its advantage of fine uniform grain, but technicians are attracted by the possibility of using materials with better magnetic properties as, for example, finely divided permanent magnet alloys such as Alnico as referred to a little later in this paper. A good review of the present position of magnetic recording is contained in a symposium held by the Society of Motion Picture Engineers.³

Electronic Circuits

There is clearly no place in a paper of this nature for a detailed discussion of the various metallurgical problems connected with electronic equipment generally. Much work has been carried out, for example, on materials for the construction of valves for sound amplification. Essentially, the principles involved are similar to those in the ordinary radio valve. A careful selection of materials is necessary in order to ensure the desired combination of working and fabricating properties, correct magnetic characteristics, with such diverse qualities as strength at high temperature to stand up to conditions in operation as well as in the manufacture of the valve, cleanliness, and freedom from gas which might be occluded during the operation of the valve, thus impairing its efficiency and life. Actually nickel and high nickel alloys are favoured for low power valve construction, particularly for cathodes, anodes, grids, support wires, etc., as this metal has the desired working properties, together with suitable mechanical properties, and especially strength to retain its shape when subject to high temperature in valve manufacture. Most important perhaps is that nickel is clean to work and can be supplied in forms which are readily "out-gassed," thus giving valves of consistently high quality. For high power valves, however, molybdenum and other metals or non-metals suitable for higher temperatures must be used.

Glass Seals

A particularly interesting problem is encountered in the provision of glass-to-metal seals necessary in the construction of electronic apparatus, including valves, cathode ray tubes, etc. The problem here is to supply a metal with expansion characteristics similar to those of glass whilst in its hard or non-plastic state. If this condition is fulfilled, then the glass and metal in, for example, the pinch of a radio valve, will cool down without the development of undue strains in the glass due to differential contraction.

As is well known, the first glass-to-metal seals were made with platinum. Later it was found that some of the nickel-iron alloys provided a wide range of expansion characteristics which rendered them suitable for matching with glass. This led to the development of the commonly used copper-clad or "Red-plat." This material consists of a nickel-iron alloy of controlled composition coated with copper, the object of which is to provide a high conductivity path for electric currents whilst also supplying a surface which will bond well with the glass.

With the increase of power used in valves, cathode ray tubes and the like, it has been found necessary to adopt harder types of glass than those previously employed. The harder glasses generally have lower co-efficients of expansion and the "Red-plat" type of alloy is unsuitable. Nickel-iron alloys are available with coefficients of expansion down to almost zero. Unfortunately, however, these alloys have low expansion characteristics only over a limited temperature range. Thus the 36% nickel-iron alloy, well known under a

variety of names such as Invar, has the lowest expansion in the series, but retains this low expansion only up to 200°C ., above which temperature the expansion rate rapidly increases. Metals such as molybdenum have been found suitable for making seals in this type of glass, but metallurgists have gone a long way towards solving the problem by developing alloys of the nickel-cobalt-iron type, now known under such names as Nilo K or Kovar, which meet the requirements of low expansion over an extended temperature range. Such alloys are widely used for making seals with glasses of intermediate hardness as used, for example, for high powered valves.

Seals with such alloys are generally of the pin type in which the alloy in wire form passes through the glass envelope of the valve. For large valves, as used, for example, for power circuits, seals can satisfactorily be made between glass and rings of the sealing alloy.

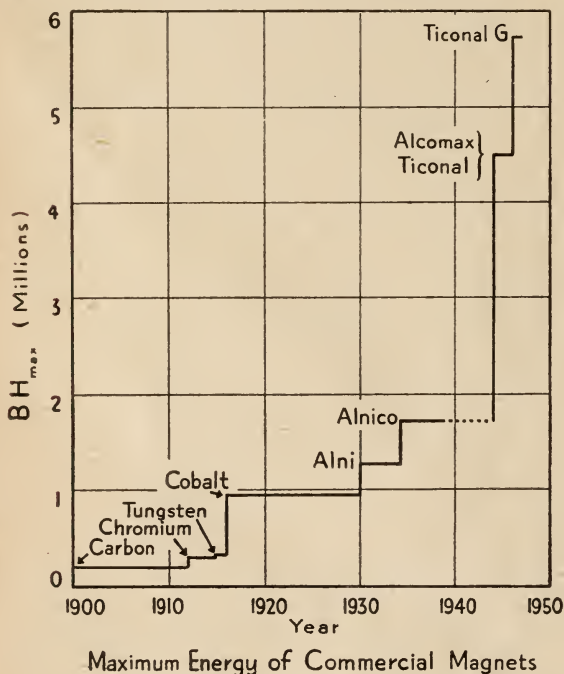


Fig. 6. Diagram showing Development of Permanent Magnet Alloys.

Alloys in this series, such as the well-known Permalloy or Mumetal, find extensive application for screens in order to prevent interference between individual components of electronic circuits. A typical application is in the screening of cathode ray tubes to prevent interference by stray outside influences.

X. PERMANENT MAGNETS

In the field of electronics generally, no development is perhaps so remarkable as that which has taken place during this century in permanent magnet alloys. Fig. 6 traces these progressive developments. It will be seen that, compared with 1900, magnets to-day are nearly thirty times as powerful. These developments are based on three main discoveries:

Between 1900 and the period of the first World War, the idea of using alloy steels for permanent magnets found expression in the use of the chromium and tungsten magnet steels, showing a useful but not very remarkable advance

High Permeability Alloys

The efficiency of amplifier circuits has been increased further by the development of high permeability alloys. Once again, the nickel-iron alloys offer special properties and find application in the cores of transformers. These alloys show many times the permeability of standard materials such as pure iron, but, at the same time, have very high magnetic permeability with low magnetic and electrical losses. This combination of properties has enabled the size of transformer units on speech amplifying circuits to be reduced to about a quarter. Another interesting application of these high permeability alloys is for shielding purposes.

over the best carbon steels previously used. During the first World War a Japanese development led to the use of cobalt in magnets, and a series of cobalt steels was put on the market, with properties up to three times those previously available. The best magnets were those containing 36% of cobalt. It is interesting to note that the cobalt steels are workable, and when used for magnets were generally in the form of hot rolled bar or sections. With the development of radio, however, cobalt steel magnets of the claw type were used in the cast form for loudspeakers and other applications.

Aluminium Alloys

The next major development took place in the early 1930s, when the Japanese again produced a new type of magnet alloy. Mishima discovered that alloys of aluminium, nickel and iron when cooled at certain critical rates possessed outstanding magnetic properties. This was the beginning of the recent development of high energy content permanent magnets. The aluminium-nickel-iron alloys were not unknown, as they had already been studied as heat-resisting materials and, in fact, some experiments had been carried out on such alloys as cutting tools on account of their extremely high hardness. It should be noted that this metal is extremely hard and brittle, and all magnets in it are made as castings and any finishing must be effected by grinding.

Later in the 1930s it was discovered in Sheffield that a further substantial improvement in properties could be obtained by incorporating a proportion of cobalt in the magnet alloy, and this led to the development and marketing of Alnico, having an energy content of 1.7 millions as compared with the 200,000 of the carbon steels available at the beginning of the century. In 1938, D.A. Oliver, of Sheffield, published a note⁴ that he had observed that when Alnico was cooled in a magnetic field the alloy on magnetising showed a further improvement of properties. This phenomenon has been studied in Sheffield and elsewhere, and it is now known that carefully selected compositions of the Alnico type can be treated by cooling in magnetic fields to give a most remarkable improvement in properties. This led to the series of alloys known as Ticonal or Alcomax. Progress in the development of these alloys is continuing, but already alloys are available with a magnetic energy content approaching 6 millions. These alloys are anisotropic—that is to say they only develop these high properties when re-magnetised in a field following the same general direction as that used during heat treatment.

This general development in permanent magnets has had important repercussions on electronics generally and on sound reproduction. The availability of these alloys means that high concentrations of field strength can be developed in the gaps in loudspeakers. They are thus the basis of modern high efficiency loudspeaker units as used in kinema and similar applications. The magnets also have important applications in short-wave radio as used for radar, etc.

XI. TELEVISION

Space does not permit of any detailed consideration of metallurgical problems in connection with television. Much that has been written above with regard to electronics generally applies in television circuits. Reference has already been made to the screening of television tubes.

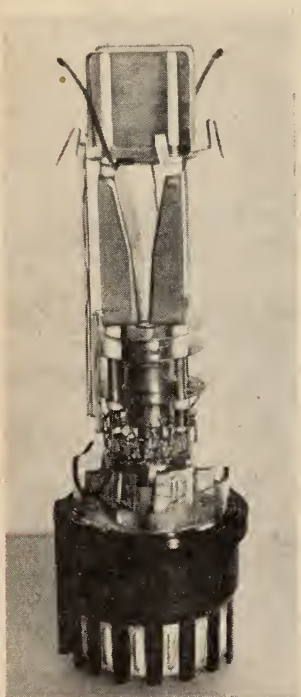
The heart of television is, of course, the cathode ray tube. As in the case of radio valves special problems arise in the selection of materials. The requirements are general workability and ease of application coupled with cleanliness, freedom from gas and sufficient strength to operate at high temperatures. A special requirement in cathode ray tubes is generally that the components must be non-magnetic. For this reason nickel-copper alloys

or stainless steel of the nickel-chromium type are generally selected. (Fig. 7.)

Particular problems arise in the construction of high intensity tubes such as are now becoming of interest for large screen television. In order to develop sufficient intensity of light on the cathode ray screen, tube components must operate at high temperatures. Similarly, hard glasses are necessary. The question of materials for high intensity tubes is still in a stage of development, but one point worth recalling is that whereas in the ordinary tubes nickel is ruled out for many parts on account of its magnetic properties, it may prove suitable for high powered tubes since nickel becomes non-magnetic at temperatures in excess of 360°C .

XII. ARCHITECTURAL METALWORK AND FITTINGS FOR KINEMAS

Much could be written on the subject of recent developments in architectural metalwork as applied to kinemas, and a good idea of the progress made in this direction is readily observable when one compares the modern theatre with those built some years ago.



Courtesy of The General Electric Co., Ltd.

Fig. 7. Internal Construction of Electrostatic Cathode Ray Tube as used for Television.



Courtesy of J. Starkie Gardner, Ltd.

Fig. 8. Close-up view of Seats in Kinema of R.M.S. Queen Elizabeth

Stainless steel of the 18/8 type has been widely used for exterior decoration on the façades of kinemas. It has excellent resistance to atmospheric attack, and will retain its bright appearance with little upkeep. Occasional cleaning is necessary in order to remove the coating of soot and dirt common to industrial areas.

For interior decoration, nickel-silver is often employed in the entrance hall and foyer, for such applications as pay box grilles, stair handrails and balustrades, radiator grilles and frames, door handles, lighting fittings, etc.



Courtesy of George Parnall & Co., Ltd. (Decorative sprayed panel designed by Jan Juta and executed by J. Starkie Gardner, Ltd.)

Fig. 9. Foyer in R.M.S. Queen Elizabeth, showing use of Nickel Silver for Architectural Decoration.

With its pleasant soft white colour it may be used to harmonise with other metals and materials without introducing a discordant note. Fig. 9 provides a typical example in this direction. In this photograph the hand-rails, balustrades, staircase trim, beading round the doors, strip lighting fittings and ventilation grilles are of nickel-silver. The design on the panel between the lift and doors has been obtained by the use of sprayed nickel and phosphor-bronze on a dark bronze background. It might be interesting to point out that this particular photograph is a view of one of the deck entrances on the R.M.S. *Queen Elizabeth* and bears a striking resemblance to many kinema foyers.

So far as fittings are concerned, particular reference might be made to the high upkeep costs incurred through the breakage of kinema seats. Cast iron is the material most commonly employed for seat frames and hinges, and a good case can be made out for a better material. In the kinema of R.M.S. *Queen Elizabeth*, seating 380 passengers, the supporting standards for the seats, as shown in Fig. 8, are built up from solid-drawn rectangular nickel-silver tube, whilst the hinged brackets on the underside are of cast nickel-silver. The upholstery is carried out in red fabric. This method of construction entirely eliminates breakage and high upkeep costs and could be usefully considered for more general use in kinemas.

CONCLUSION

In view of the very extensive field covered by metals in kinema and related equipment, it is quite impossible to deal with every aspect of the subject in this paper. It is appreciated that more detailed reference could have been made to such equipment as reduction printers, perforators, splicers, exposure meters, etc., but it is hoped that in the examples cited sufficient has been said to provide at least a guide to the many metallurgical problems associated with the industry.

Acknowledgments

The authors wish to acknowledge their indebtedness to the Directors of The Mond Nickel Company, Limited, for permission to publish this paper.

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3. Six papers in the *Journal of the Society of Motion Picture Engineers*, 1947, XLVIII, Jan., describing recent developments in the field of magnetic recording.
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DISCUSSION

Mr. I. D. WRATTEN : I can certainly confirm Dr. Everest's remarks with regard to the suitability of Inconel for processing plants. I have had considerable experience both here and in the United States with work of that type, where the purpose has been to find out which is the most suitable metal for processing equipment—actually with one of the gentlemen named, Mr. Crabtree. If I remember it we were not so keen on Monel for some of the purposes for which it is actually used here, preferring the 18/8 type stainless steel, but it would appear that Monel stands up extremely well.

Mr. W. BUCKSTONE : In the case of interconnected units of different specification, would it be normal to have insulation between the various components, so that corrosion cannot set up between them ?

Dr. A. B. EVEREST : I think the solution of the problem lies in the suggestion of employing insulating links between the components.

Mr. L. KNOPP : I have had some experience with the use of austenitic electrodes. Are they employed for welding austenitic steel, or what electrodes are used for that purpose ? What effect does it have on that which is welded ? Is there any likelihood of electrolytic corrosion taking place ?

Some mention was made of the ageing process of aluminium alloy whereby strength

was very considerably increased. I wonder whether Dr. Everest could enlighten us a little on that subject.

Dr. A. B. EVEREST : First with regard to the welding of stainless steel. I believe that for most of these corrosion-resisting materials you can obtain electrodes of the same or very similar material. Whether this is true for all grades of stainless steel I am not certain, but I can find out.

On the question of ageing aluminium alloys, a full explanation would involve a lecture on precipitation hardening. Briefly, there is a large number of metals which contain one constituent which is soluble in the matrix at a high temperature and not at lower temperatures. The difference in solubility is such that if the alloy is cooled quickly it will retain the special constituent in a state of super-saturation. Then by low-temperature treatment it will separate from the matrix in such a manner as to harden and strengthen the metal. "K" Monel is a typical example. Use was made of this principle in diesel-engine pistons.

Mr. KNOPP : With the ageing of an alloy is there a change in the crystalline structure of the metal ?

Dr. A. B. EVEREST : The constituent which separates on precipitation can sometimes be identified, but it is generally almost sub-microscopic.

BACK PROJECTION AND PERSPECTIVE

*Read to a joint meeting of the British Kinematograph Society
and the Association of Cinema & Allied Technicians on 16th April, 1947*

I. INTERLOCKING AND FILM STEADINESS

George Hill*

THE first requirement in the back projection process is to ensure that the camera and projector shutters are open at the same time. These shutters must be accurately locked together so that the camera exposure bears a definite relation to the time of projection of each frame. This lock must be maintained without slip or phase lag from standing position to full speed during the whole time of running.

Interlocking Systems

There are several ways of effecting an electrical interlock, most of them being based on the Selsyn system, in which the rotors and stators of the motors are supplied separately, the supplies coming from a complex master machine. The master machine must be driven from a constant source, such as a three-phase controlled frequency supply, in order that its speed may be accurately maintained.

The following method of using ordinary three-phase synchronous motors has been evolved. On the shaft of each motor is fitted a distributor with one conducting segment in it; carbon brush contacts and a pilot lamp are also fitted. One of the motors is so mounted that its stator is capable of being rotated. The distributors and lamps of both motors are connected in series by means of a cable, and supplied with 230 volts A.C. The rotors are turned until both pilot lamps light, and the motors are then locked to the machines, one to the camera and the other to the projector—both of which have their shutters open. The motors can now be started up, either together or separately, and when both are up to speed, synchronism of both shutters can be obtained by moving the "free" stator, the lamps lighting when both shutters are open together.

One disadvantage of this method is waste of film stock due to the time taken in obtaining synchronism of the two shutters, but it has the advantage that the projector can be started up before the camera; this is sometimes done when the B.P. plate is a long one and the "Action" occurs near the end of it, in which case, considerable "picture" footage may be saved.

Film Feed Mechanism

The mechanisms for projecting and photographing these effects should be all of a standard type. For the absolute steadiness required today, the register pin has become a vital part of the mechanism. Some mechanisms rely on side and front pressure only, but this is not sufficiently accurate for most background work.

All precision types of camera use two register pins, one fitting the perforation exactly, and one vertically only. This method requires only back pressure to keep the film in its correct focal plane. The Bell and Howell shuttle gate, is in the author's opinion, the most successful of all in this respect, but has the disadvantage of being noisy; the film is carried between two metal plates and lifted by a drunken cam from moving claws on to fixed register pins.

Since the arrival of sound, gates with moving register pins relying on spring back pressure have, by reason of their silence, been generally used. The objection to this method is that the register pins are moving whilst the

shutter is opening and closing, and if the perforation holes are small due to shrunken stock or worn punches in the original manufacture of the stock, it is possible for the register pins to pull the film from its focal plane and give an effect on the screen known as "breathing." Thanks to the untiring efforts of the manufacturers, this trouble is seldom experienced, and only when stock is very old.

Maltese Cross Systems

The standard projector mechanism has a Maltese cross pull-down movement with a long gate, and relies on side and front pressure (in conjunction with spring rollers at the top of the gate to prevent side sway) for registration; the sprocket is at some distance below the aperture. Too much front pressure can pull the film one way or the other in the long guides, and too much side pressure can buckle the film and affect definition.

For back projection purposes these pressures should be capable of being adjusted during running so as to obtain the best result. The Simplex E-7 is the only machine known to the author which has this advantage.

Projectors of this description are useful for all moving shots such as car chases, etc., where the background is constantly changing. For static backgrounds the conditions are much more exacting. When a subject is placed in front of a fixed object, such as a building or a bridge, or, for example, where part of a set is built to join up to a B.P. plate, absolute steadiness is vital, and camera mechanisms have been converted to take the place of the Maltese cross in projectors.

At the moment, there is no standardised position for the registration pins: some are placed at the top of the aperture and others at the base. The importance of using the same registering holes in photographing, printing and reproducing cannot be over-stressed. The positive stock must have negative perforations in order to ensure a true registration.

Gate Cooling

Because of the high current taken by the projector arc, usually in the region of 200 ampères, many studios have experimented with systems for cooling projector gates. "Dry ice" (solid CO₂) was used with success by Stoll Studios in the early days. Air blowers are also used and are still being experimented with in an endeavour to get them more silent.

Much has been said about the elimination of "hot spots"; many people have claimed to have cured it, but the old method of using filters is still in use.

Camera Rigidity

In photographing backgrounds, the importance of rigidity of the camera cannot be over-emphasised. Often a camera is placed on a tripod not properly chained down, the head jacked off, and sometimes on a rostrum with only light boarding. Obviously, any movement of the cameraman or his assistants sets up vibrations, which are very apparent in the final results. By the construction of special stands with a heavy base, and by shielding the camera from the wind, all possible risks of vibration due to these problems can be considerably lessened.

Equally important is the laboratory processing, and the use of fine-grain stocks both in the original negative and the projection prints made from it.

II. PROJECTION

Alfred Davis*

IN the projection of motion pictures, it is highly desirable that all portions of the screen be equally illuminated. The crater of the carbon arc, practically uniform in intrinsic brilliancy and providing a large volume of

*Supervisor of Projection, Gainsborough Studios

light within a small area, is readily focused on the aperture plate in a beam of uniform intensity. No other form of light compares at the moment with the carbon arc in its adaptability to the problem of projection.

The light source commonly employed consists of a 200 ampère direct current high-intensity arc, burning a 16mm. diameter hard-shell positive carbon with a soft core impregnated with certain salts, chiefly cerium, and a 12mm. copper-coated cored negative.

To obtain sufficient concentration and steadiness of light for projection purposes, it is necessary to control in some way the combustion of core salts, as by rotating the positive carbon, thereby burning a deep crater in the impregnated core, which gives a very high brilliance. To maintain this intense brilliance, the negative arc stream compresses or confines within the crater of the positive carbon a substantial portion of the incandescent vapours emitted from that point.

The correct relative position of the carbons is of importance for the production of a steady light at the correct amperage. Three possibilities are

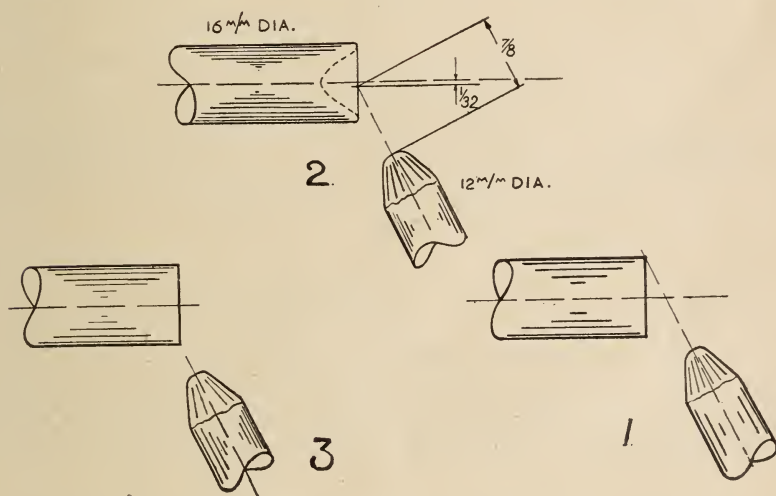


Fig. 1. Burning Positions of H.I. Carbons. (1) Negative flame does not touch the lower part of Positive Carbon, thus allowing the Gases to roll out. (2) Negative Flame contacts Positive (position of maximum efficiency). (3) Negative Flame overlaps Positive.

illustrated by Fig. 1. These three positions give entirely different results in quantity and quality of crater light, the light diminishing when moved from position 2 to position 1 or 3. The useful light from the arc is steadiest when the edge of the negative flame is on the lower part of the positive crater as shown by diagram 2.

Optical System

The most efficient optical condensing system is the Bausch & Lomb "Cinephor" system, which employs two lenses of unique design. The rear lens of this type has one spherical and one cylindrical surface; the front lens has one spherical and one parabolic surface. These condensers produce an oval spot more in keeping with the film aperture, instead of the circular spot produced by plano-convex lenses.

The lenses used on the projector range from 4 in. to 8 in. focus in $\frac{1}{4}$ in. steps. The average throw is 60 to 70 feet. The lens used on the camera side is usually of 75 mm. focus, which allows for foreground movement in shots of

this description, and provides less fall-off of light transmitted to the screen, compared with shorter focal lenses such as 40 or 50 mm.

Processing

When a B.P. plate has been shot, the print is seen the following day, and if satisfactory, the negative is sent to the optical printer for a positive steadiness test and printer light strip. If the steadiness test is satisfactory, the negative is graded and three prints are made, one to be used at rehearsal, to balance foreground lighting, and two for actual shooting. These are carefully examined for surface dust and blemishes which may occur during printing period.

The Screen

The screen used for B.P. is a translucent screen constructed by spraying 30 to 40 coats of cellulose on to a flat plaster matrix; when set, the screen is stripped, giving an etched or sand-blasted surface. The edges are bound and eyeleted, and the completed screen is suspended by rubber bands from a steel or wooden frame to allow for expansion or contraction due to temperature variations.

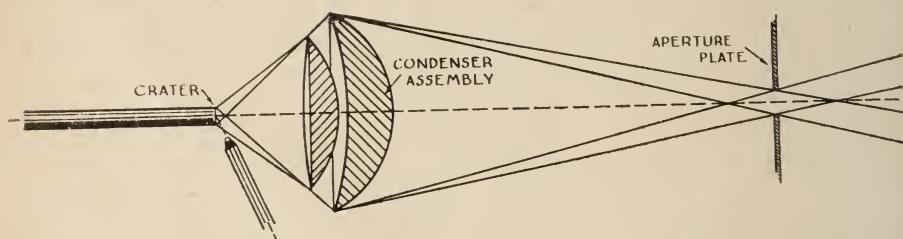


Fig. 2. Bausch & Lomb "Cinephor" Condenser System.

These screens are kept clean by washing with soft soap and warm water, sprayed with cold water from top of screen to wash away any traces of soap, and left to dry. This cleaning process takes place after each production to ensure that the image projected upon the screen is not impaired by dust or dirt which collects upon the surface.

III. PROBLEMS OF PERSPECTIVE

John Gow*

FOR the production of a true illusion in back projection, perspective projection (the latter word used in the draughtsman's meaning) is essential. In the past it has not been used to a sufficient extent.

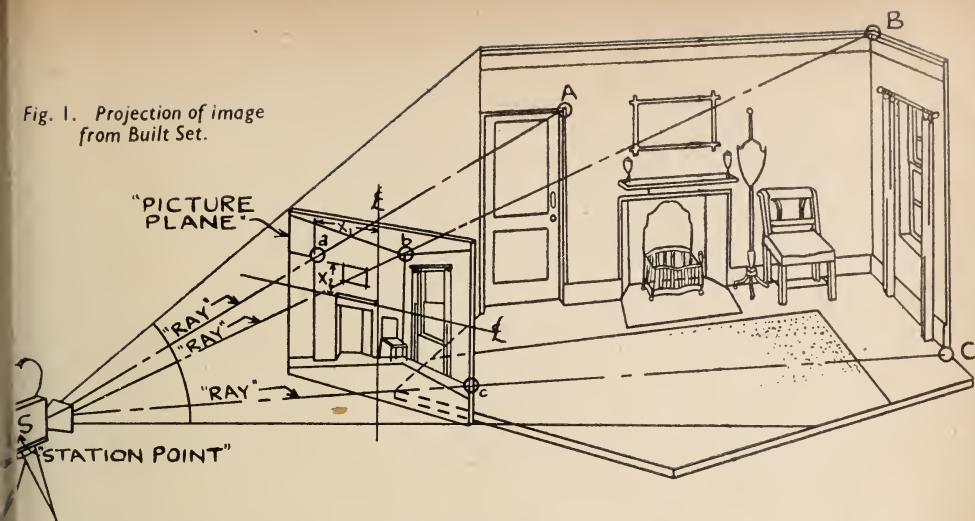
Many back projection plates have been spoilt because of lack of co-operation between projection and art departments. This situation is improving in most studios, but one or two still believe in guesswork and visual appearance.

Planning for Photographing Plates

In some cases it is necessary for the Art Department to work out on paper the necessary action of an artist and the distances he will have to be away from the camera, before the cameraman goes on location to procure his plate, especially if a wide angle is necessary for taking owing to limitations of surroundings or limited shooting space.

*Production Facilities (Films) Ltd.

Fig. 1. Projection of image from Built Set.



The kind of thing that can happen if pre-planning is not used can be shown by this example :

A projected moving picture of a child is thrown on to the transparent screen; the parents are standing in front of the screen, and between screen and camera; they look towards the screen as the child runs towards the camera, to pass out of the picture. The shot is unsuccessful because the child in running towards the camera becomes greater in size than the parents. This fault is due to the child having been photographed on location with a wide-angle lens, and in the studio with narrow angle lens. Had this fact been considered beforehand and the comparative distances worked out on the drawing board, this would not have happened.

Camera Elevation

Other examples of shots having proved unsuccessful, or unsuitable, are many. Some of the main troubles are due to the over-zealous cameraman who, in order to procure an interesting composition, sets the camera too high or too low. In the first case an artiste placed in front of this picture will have only his head in the composite shot, and that will be at the bottom of the frame. If the artistes are placed within the picture to form an interesting composition they will apparently be standing in air. The reverse can, of course, happen when a low angle plate is used.

A tilt up or down when processing a plate may cause considerable trouble when shooting in the studio.

Normally the camera in the studio is set at the same angle as the one on location, with the screen and projector along the axis of the picture ; if the location camera is tilted downwards, the screen being at right angles to the axis is tilted and elevated from the studio floor. The projector at the other end of this axis is placed high in the studio and tilted down. Any artiste in front of the screen remains in a vertical position.

These shots can be worked out if due consideration is given beforehand, but the Art Department must be contacted before proceeding on a shot of this nature.

Perspective Projection

A few simple examples of what not to do have been mentioned, but so far the application of perspective projection to back projection has not been explained. As the two names imply, they have something in common : namely, the word projection.

Fig. 1 will help to show the connection. Here we have a room and a camera, but between the room and camera a screen or picture plane has been placed ; this represents later the back projection screen on to which the picture is projected.

By connecting points in the room through the screen to camera, we establish points which when connected together form a flat picture of the room on the screen. It can be seen then that we are able to produce a picture from a three dimensional plan and elevation.

Producing Plans for Perspective Views

Fig. 2 shows the method commonly used in studios to-day, having plan and elevations set up in position and the picture planes for plan and elevation forming two sides of the final picture; again by plotting points it is possible to complete a picture within the frame.

But it is also possible to reverse this process and to obtain a plan and elevation from a picture. Certain information is, however, necessary: first the

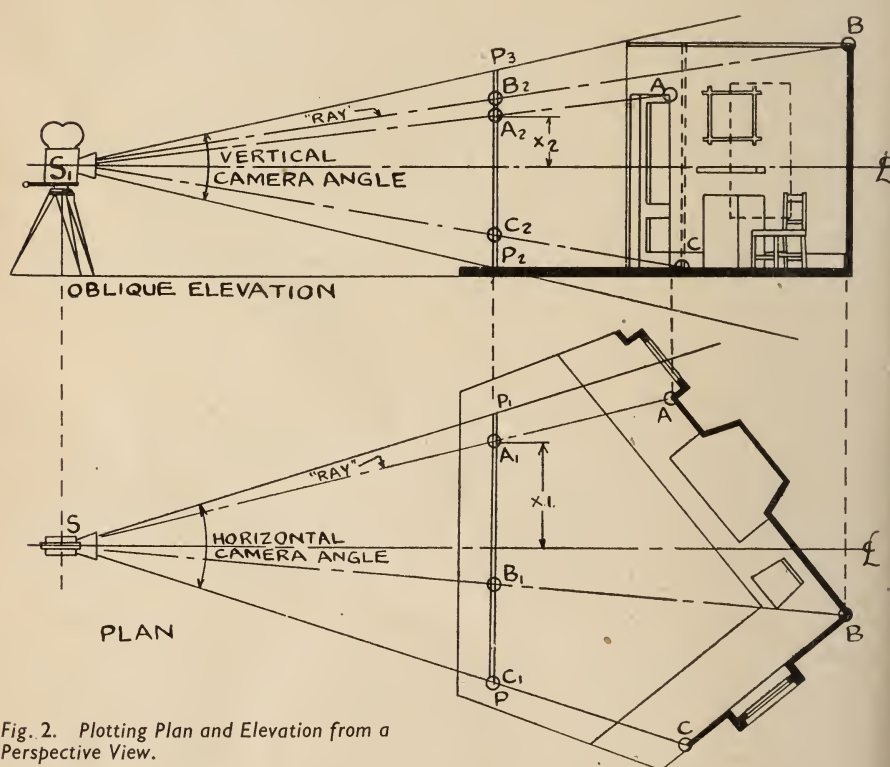


Fig. 2. Plotting Plan and Elevation from a Perspective View.

focus of the lens that has been used to take the picture, the height of camera when taking the plate, whether the camera was tilted or twisted when taking and in the case of still plates whether parallax was adjusted or the photograph trimmed.

Focal Length of Lens

Perspective projection can in most cases give the answer. Simpler formula will be briefly discussed: first the problem of finding the focal length of lens used in procuring pictures.

Fig. 3 shows an untrimmed picture which has been taken with the camera level, the horizon being through the centre of the picture. If the camera is tilted up, the horizon is below centre, and if tilted down, above centre of picture.

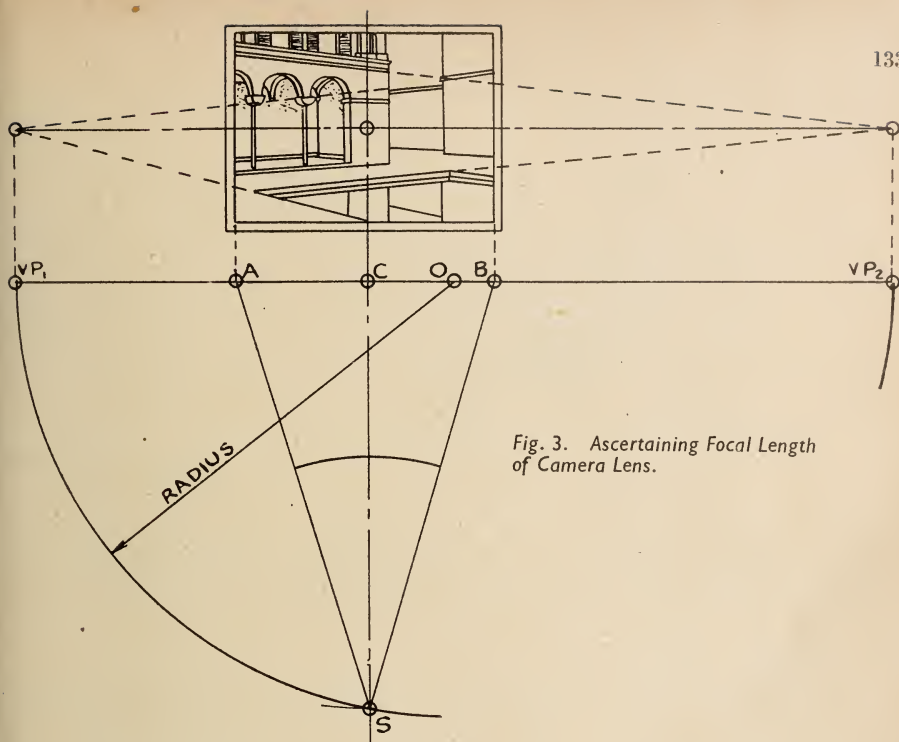


Fig. 3. Ascertaining Focal Length of Camera Lens.

Lines are projected from the side of the building to the horizon on each side of the picture. Underneath is drawn a line parallel to the horizon, the distance between the two vanishing points is bisected, and a semi-circle described below this line. A line through the centre of picture drawn at right angle to this line cuts it at C ; its point S of intersection with the arc will give us the angle of lens used, namely, ASB .

Once the focal length is known it is possible to take the next step, that of procuring from a picture the plan and elevation. Fig. 4 illustrates what happens when a different taking lens is used in the

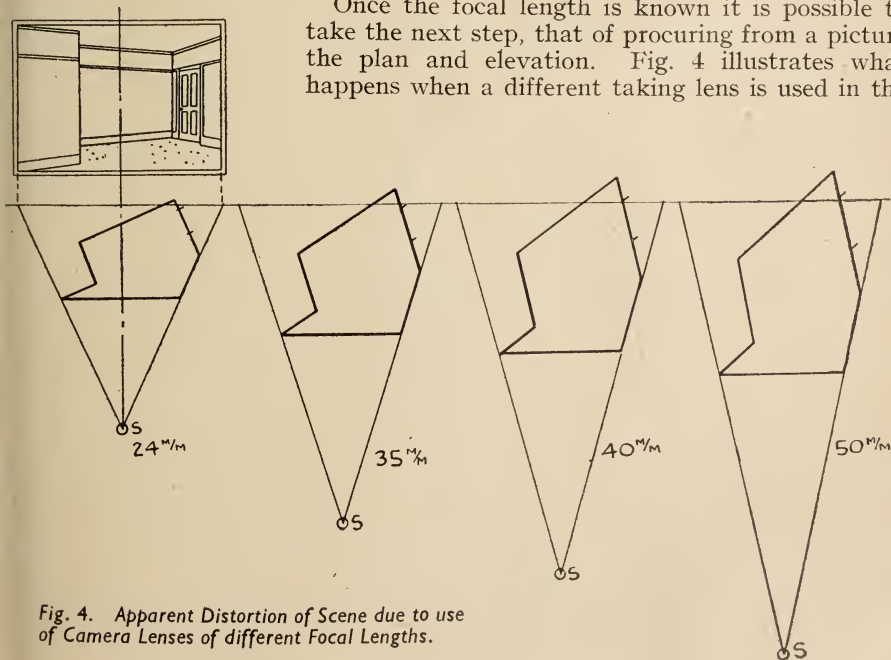


Fig. 4. Apparent Distortion of Scene due to use of Camera Lenses of different Focal Lengths.

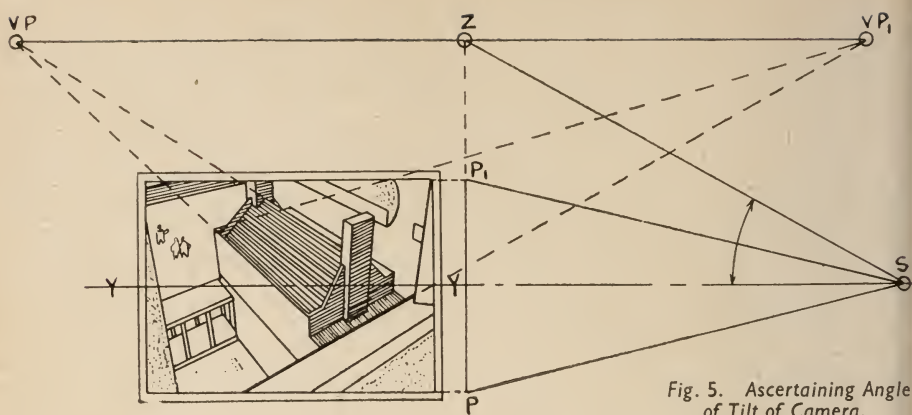


Fig. 5. Ascertaining Angle of Tilt of Camera.

studio to that used to procure the picture. With the taking lens of the same focus in both cases, the angle of the room remains at 90° , but when a narrow angle lens is used in the studio this angle distorts the room, which has apparently changed its depth.

Ascertaining Camera Elevation

Fig. 5 indicates one of several methods of ascertaining the angle of tilt of the photographing camera. Lines are produced to the vanishing points, fixing the horizon line VP, VP_1 . At a convenient distance from the frame, set up a picture plane PP_1 and describe the required camera angle PSP_1 . Produce the line PP_1 to Z , when the angle ZSY gives the angle of tilt of the camera.

Given a photograph or sketch, the focal distance and a dimension being known, it is possible to construct from it the plan and elevation of an object.

Computation of Dimensions

The usual method of obtaining a height dimension from a photograph is from a door opening. For the most part, doors are from 6 ft. 8 ins. to

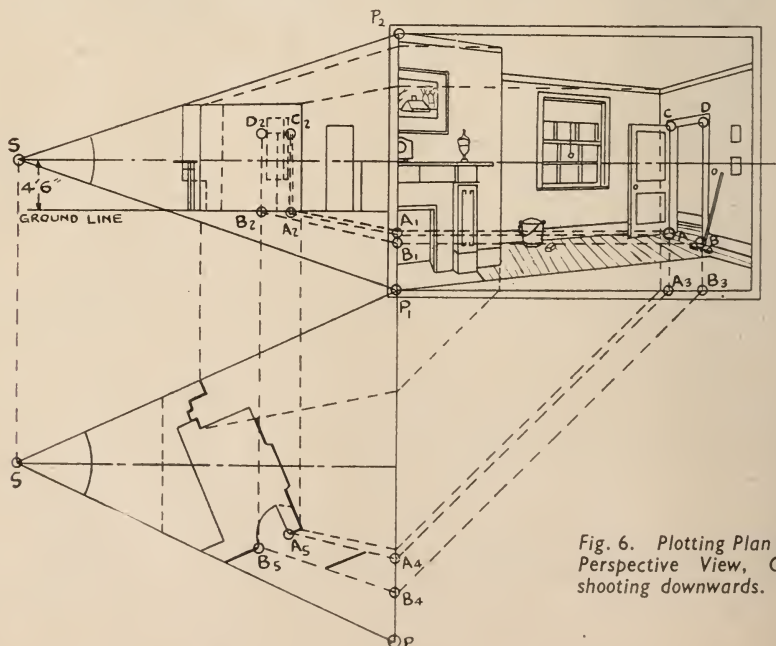


Fig. 6. Plotting Plan from a Perspective View, Camera shooting downwards.

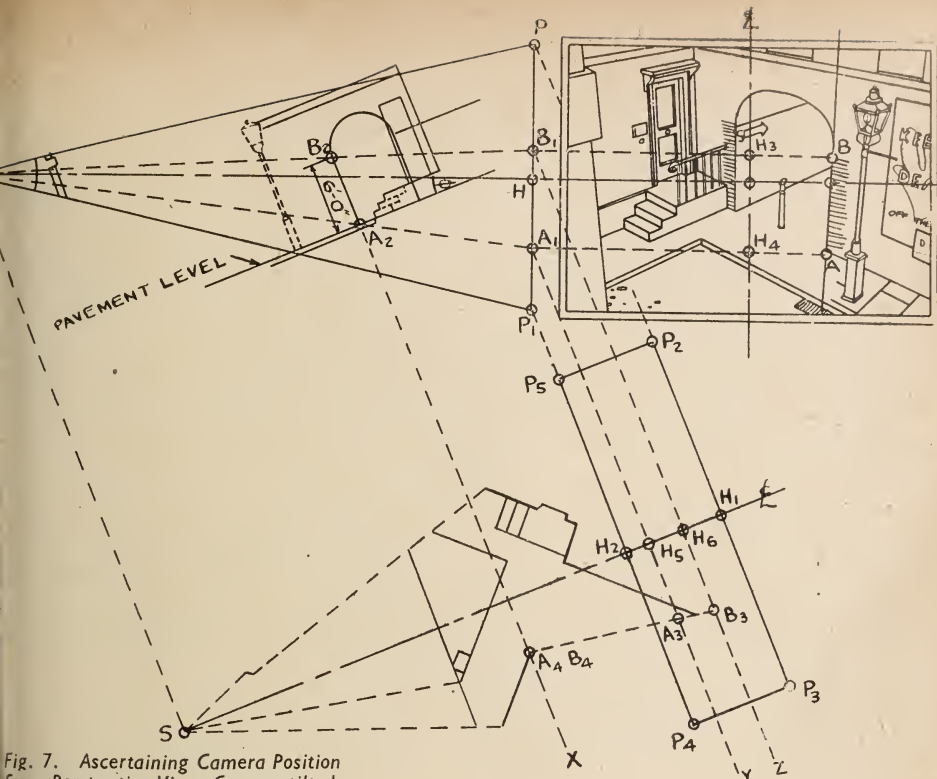


Fig. 7. Ascertaining Camera Position from Perspective View, Camera tilted.

7 ft. in height and it will be found that if 7 ft. is taken as an average the results will be sufficiently accurate. Another method is by counting brick courses, which normally run four to the foot. Other methods such as sill heights, figures in the pictures, etc., will suggest themselves. In Fig. 6 it is assumed that the door is 7 ft. high. From this the height of the camera, *i.e.*, the distance from the horizon or—as the photo is trimmed—the horizontal centre line to the junction of door jambs and floor, is found to be 4 ft. 6 ins.

The vertical camera angle $P_1S_1P_2$ is set up against one edge of the photograph (P_2P_1) and the ground line drawn at 4 ft. 6 ins. to the scale chosen, below the centre line. The plan of picture plane and the horizontal camera angle are set up at P_1SP . The steps required to obtain the plan and elevation of door openings are as follows :

1. Project points A and B across to cut P_1P_2 at A_1B_1 , and through S_1 draw rays to cut ground lines at A_2B_2 .
2. Project down points A and B to cut bottom edge of photograph at A_3B_3 and project across at 45° to cut P_1P_2 at A_4B_4 . From A_2B_2 drop vertical lines to cut rays drawn from A_4B_4 to S at A_5B_5 .

Then A_5B_5 represents the position of door opening on plan. To complete the oblique elevation of door, project points C and D across to P_1P_2 , back to S_1 , and where the rays cut verticals from A_2B_2 at C_2D_2 is the door head in oblique elevation.

For a plunging shot as Fig. 7, in addition to the focal distance or camera lens angle, it is necessary to determine by one of the methods already shown, the angle of tilt and lateral cant, if any.

These being known, the picture plane PP_1 is set up, and the centre line SH_2H_1 drawn parallel to a true horizontal line, *i.e.*, at the angle tilt to the vertical centre line HS_1 . The oblique picture plane $P_2P_3P_4P_5$ is then drawn.

By counting the brick courses it has been possible to deduce that the side

of arched opening AB is 6 ft. high approximately. The steps required to obtain true plan and elevation are as follows :

1. Project B and A across to cut PP_1 at B_1 and A_1 . Draw from A_1B_1 rays to S_1 .
2. Set adjustable set-square to the angle true verticals make with the camera centre line S_1H and set dividers to 6 ft. to scale chosen. Slide adjustable set-square along tee-square until the distance 6ft. 0 ins. can be marked between rays from A_1B_1 , i.e., at A_2B_2 . Then A_2B_2 is the edge of arch opening in oblique elevation. Draw pavement level through A_2 .

These are only a few of the many problems that can be solved by perspective projection, and with this knowledge it is possible to place in front of the back projection screen additional buildings, or foreground in correct relation to the projected picture, so that when photographed, scale and composition of the composite is perfect.

DISCUSSION

A VISITOR : Have you any experience of B.P. in colour ?

Mr. A. DAVIS : The only colour B.P. we have done was for "Jassy." I understood from Technicolor that we had more light than was needed.

Mr. F. RODKER : If the camera has to be on the same focal axis as the projector, how do you get rid of the hot-spot from the lens?

Mr. A. DAVIS : The screen is sometimes sand-blasted to give a slightly greater density in the centre than at the edges. The longer the focal length of the lens, the less the hot-spot.

Mr. LAMBERT : Can you give any rules for the focal length of the lens for shooting a plate?

Mr. J. GOW : When you have a plate of a seascape or landscape with no architectural features, almost any lens can be used. But if you are shooting an architectural subject, it is advisable to use the same lens in the studio as for shooting the plate, otherwise you get distortion.

Mr. R. ELTON : What do you consider the shortest practicable throw for transparencies or slide background plate?

Mr. A. DAVIS : That depends upon the size of the screen. In our case the screen is 20 ft. \times 18 ft., the image on the transparency

is 2 in. wide, the projected image being about 17 ft. wide, and the lens used is 7 ins., with a throw of roughly 60 ft.

Mr. R. ELTON : Many years ago we overcame the hot-spot by suspending in front of the projector a piece of gelatine, shaded at the edges.

Mr. A. DAVIS : Yes ; but you are distorting the focus.

Mr. B. HONRI : In the past we have had difficulty with the B.P. process, because people objected that it used too much studio space due to the long throw. Ultimately we got down to fairly good results with a throw of about 25 ft. I am wondering just how short it is possible to get the throw.

Mr. J. GOW : An idea we have discussed in the last year or so is to accommodate built tunnels on the floor, in order to give us the throw. If you use a wide-angle lens you get falling off at the edges, you get distortion, and the picture has a hot-spot. It is essential to have the necessary studio space.

Mr. FRANKS : Is the print that is used of normal density, or is a special print made?

Mr. A. DAVIS : That depends largely on the foreground. If you have a dark foreground you need a contrasting print, if the foreground is light in tonal value you want a medium print.

R.P.S. SCIENTIFIC AND TECHNICAL GROUP

The Scientific and Technical Group of the Royal Photographic Society has instituted a scheme whereby members of societies approved by the Council are permitted to attend meetings of the Group, and to receive individual invitations to such meetings, on payment of an annual subscription of 5s.

Members of the B.K.S. (other than those who are already members of the R.P.S.) are invited to participate in this scheme. Those wishing to avail themselves of it should make application to the Hon. Secretary of the Group, 16, Princes Gate, S.W.7.

The remainder of the programme for the 1947-48 session is as follows :—

Thursday, 15th April, 1948.—"Speed and Contrast in X-ray Work," by H. S. Tasker, M.A.

Tuesday, 20th April, 1948.—Symposium on Modern Technique in Stereoscopy.

Thursday, 29th April, 1948.—"Tone Control with Unsharp Masks," by G.A. Jones, M.A.

Thursday, 13th May, 1948.—Symposium on Reversal Development.

Thursday, 27th May, 1948.—"Subjective Contrast." by Dr. W. Swift.

TECHNICAL ABSTRACTS

Most of the periodicals here abstracted may be seen in the Society's Library

CRITICAL FREQUENCY OF FLICKER AS A FUNCTION OF ILLUMINATION.
J. L. Jahn, *J. Opt. Soc. Amer.*, No. 2, Feb., 1946. (Based on *Science et Industries Photographiques*, May/June, 1946.)

The author derives an equation correcting the critical frequency for flicker with illumination from the photochemical theory of vision. Whilst that of the same general form as that previously obtained by Hecht, it is more easily adjusted to fit the experimental values. Where discrimination is possible, experiment favours the new equation. M.V.H.

INFLUENCE OF THE METALLIC IONS OF A DEVELOPING SOLUTION.
Mme. A. Lous-Labetoulle, *Science et Industries Photographiques*, March/April, 1946, p. 65.

The author has investigated developers containing sodium or potassium sulphite and sodium or potassium carbonate, and also the efficacy of sodium or potassium bromide in fog prevention in these developers. She concludes that the developer containing only potassium ions is more active than that containing only sodium ions, those containing both ions being similar and intermediate in activity; potassium bromide is more efficient in fog prevention in the developers containing mainly or only sodium ions, but sodium bromide is more effective if only potassium ions are present. M. V. H.

GROUND NOISE AND GRAININESS OF SOUND TRACKS.
A. Narath, *Kinotechnik*, Nos. 5-6, June, and Nos. 7-8, Aug., 1946. (Based on *Science et Industries Photographiques*, May/June, 1946, p. 173.)

The author has investigated the ground noise level under varying conditions of development, etc., for various Agfa films. He concludes that neither graininess nor granularity gives a reliable measure of ground noise level, which shows a maximum when plotted against transparency. He has also determined the spectra of the ground noise under varying conditions. M. V. H.

SPACE ACOUSTICS.
James Y. Dunbar, *J. Soc. Mot. Pic. Eng.*, Oct., 1947, p. 372.

In a broad review of progress in practical acoustics the author suggests a direct influence of acoustic surroundings on the evolution of music from primitive civilisation to the present day. Several modern acoustic treatments are described in general terms and illustrated. N. L.

THE SCALING OF LAMPS IN FILM PRINTERS.
P. Kowalski, *Travaux Soc. Polonais Internes en Suisse*, 1944. (Abs. *Science et Industries Photographiques*, July/August, 1945, p. 239.)

The author describes two methods of adjusting the values of the resistances of a light change box for a film printer to give equal steps of log exposure, measured as actinic light. The first is a connection method for adjusting an existing resistance box, the second is an orderly (if laborious) procedure to set up a box from first principles. M. V. H.

A PHOTO-ELECTRIC FILM CUEING SYSTEM.
Erwin A. Moon, *J. Soc. Mot. Pic. Eng.*, Oct., 1947, p. 364.

The use of metal staples, edge notches, or separate cue rolls to control printer light changes for special effects may be avoided by using white lacquer cues on the edge of the negative in conjunction with a photo-electric scanning head. The construction of this head and the essentials of the associated amplifier-relay set up are described in some detail. N. L.

MAGNETIC TAPE RECORDER FOR MOVIES AND RADIO.
Richard H. Ranger, *Electronics*, Oct., 1947, p. 99.

This article describes a high quality magnetic tape recorder with a response from 32 to 9,600 cycles per second. The author gives details regarding the circuit, construction of the head, amount of bias in conjunction with the audio signal, as well as mechanical tolerances for accurate alignment and spacing of the gap in the magnetic head. He also mentions the importance of equalisation in the amplifiers and of constant speed for the tape, and refers to a new editing aid which he calls a "word spotter." O. K. K.

TECHNICAL DATA ON THE CONSTRUCTION OF FILM STUDIOS.

Cottet, *Technique Cinématographique*, Oct. 16, 1947, p. 1239, Oct. 30, 1947, p. 1259.
A patented principle of studio construction consists in the provision of a damped tubular

scaffolding surrounding the stage, carrying sets and lighting, entirely separated from the double or triple metallic walls, which serve merely to exclude noise and weather. The area inside the scaffolding is recessed below ground level, enabling the level of the floor to be varied by means of rostrums.

R. H. C.

TELEVISION STUDIO LIGHTING.

W. C. Eddy, *J. Soc. Mot. Pic. Eng.*, Oct., 1947, p. 334.

The introduction of television cameras with higher sensitivity enables more artistic lighting to be devised. A new system of lighting installation enables one operator to control and completely operate from a flying grid the entire studio lighting.

T. M. C. L.

APPLICATIONS OF TELEVISION TO CINEMA PRODUCTION TECHNIQUE.

Y. L. Delbord, *Bull. Assoc. Française des Ingénieurs et Techniciens du Cinema*. No. 1, 1947.

The author describes two techniques embodying photographing the image on a television tube: the electronic intensification of a flat negative; and the combination of two scenes in any desired manner.

M. V. II.

THE ELECTRIC SUPPLY SYSTEM IN A FILM STUDIO.

J. Chastagnol. *Electricité*, Vol. 30. No. 114, March, 1946 (based on *Science et Industries Photographiques*, Aug./Sept., 1946).

The author surveys the problem of the supply installation, arising from the facts that almost the whole load may be required at any point in the studio, ar lamps must be easily moved by semi-skilled personnel without the usual electrical precautions; to avoid noise both arcs and "inkies" are fed with D.C. and care must be taken to avoid commutator or tooth ripple. The author considers that the D.C. supply is best produced from rotary converters or groups of rectifiers with smoothing filters. Since protection is difficult due to the wide load variation, the author prefers to supply each lamp from a fixed contact box.

M. V. H.

PHYSICAL SOCIETY EXHIBITION

At the annual exhibition of the Physical Society, held at the Imperial College, South Kensington, from April 6th to 9th, the Society was again granted the use of the small lecture theatre.

The Society's exhibit, entitled "Physics and the Motion Picture," had the object of explaining where in the photographic process the various pieces of equipment found in the modern laboratory and studio had their place. It was centred upon four charts (reproduced opposite), coloured tapes associating the various pieces of equipment with the appropriate theoretical step.

Thus, on the first chart, three types of densitometer were indicated—the Western Electric¹ and the Capstaff (both kindly lent by Denham Laboratories, Ltd.) and the new Ilford model²; the exposure meter displayed was the scanning type recently developed in the G.E.C. laboratories³, in which the brightness of various sections of the scene is indicated in the form of lines of varying length on a cathode-ray tube.

In the second and third charts, the factor associating negative density and positive exposure is the printer light control. The figure 1 related to a Bell & Howell Model "D" printer.

On the fourth chart, pH control and chemical analysis were represented, the former by illustrations of the Cambridge

pH meter, and the latter by a display of chemical apparatus, arranged by the research staff of Denham Laboratories.

Other demonstrations included a device used by the G.E.C. laboratories for demonstrating the refraction of a Fresnel lens (like the exposure meter, its arrangement by Dr. F. S. Hawkins); transparencies, by Dufay-Chromex, Ltd., showing enlargements of the Dufaycolor réseau; a series of curves, specimens and enlargements illustrative of the various types of Gevaert film stock; and a Westrex sound head, shown by courtesy of the Western Electric Co., Ltd.

At hourly intervals a 16 mm. film, prepared by Messrs. H. S. Hind and W. M. Harcourt, was projected, which demonstrated the effect upon picture and sound of incorrect processing. On the same scene the effect was shown of incorrect exposure and incorrect development; on a length of sound track, consisting of music and dialogue, the results were heard of incorrect exposure, over-development of a density track, and treble and bass cut-off.

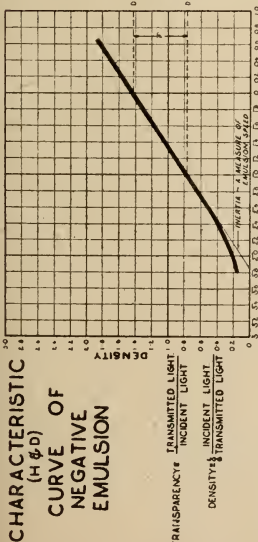
The film was projected on an Ampre projector, which with the projectionist was kindly lent by Sound Services, Ltd.

1. *J. B. it. Kine. Soc.*, Vol. 8, No. 4, p. 82

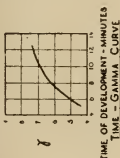
2. *Sub-Standard Film*, Nov., 1947, p. 19

3. *Brit. Kine.*, Vol. II, No. 2, p. 47.

CHARACTERISTIC CURVE OF NEGATIVE EMULSION



TRANSMITTANCE TRANSMITTED LIGHT
INCIDENT LIGHT
DENSITY IS MEASURED BY MEANS OF -
DENSITOMETER
NEGATIVE EXPOSURE IS ESTIMATED BY MEANS OF -
EXPOSURE METER



TIME OF DEVELOPMENT-MINUTES
DENSITY

$$\gamma = \frac{D_2 - D_1}{\log E_2 - \log E_1}$$

GAMMA REPRESENTS ONE ASPECT OF CONTRAST
STOCK CHARACTERISTICS
TEMPERATURE OF DEVELOPER
COMPOSITION OF DEVELOPER
ALKALINITY OF DEVELOPER
ADDITION OF DEVELOPER
GAMMA IS ASCERTAINED BY MEANS OF -
SENSITOMETER.

LOG EXPOSURE (METRE-CANDLE-SECONDS)

PRINTING



NEGATIVE

Negative is developed to constant Gamma.
 $\delta_N \times \delta_P = \delta_{WP}$ = Approx 1.3
Positive Exposure is adjusted to compensate for varying negative densities by means of -



Positive Exposure is adjusted to compensate for varying negative densities by means of -

PRINTER LIGHT CONTROL



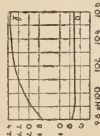
POSITIVE

Positive is developed to a constant density of a given step on Sensitometer Strip. This Density is plotted on -

CONTROL GRAPHS

1

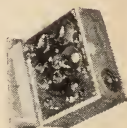
POSITIVE DEVELOPMENT



Effect of pH on Development

The principal factor in maintaining consistency of development is Alkalinity, measured on -

pH METER



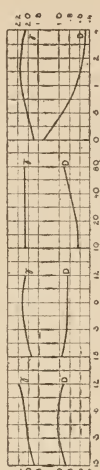
Cambridge Titration Apparatus

CHEMICAL ANALYSIS

Positive developing baths are commonly kept in use for weeks or even months, being maintained by continual replenishment. Their composition is controlled by means of -



METOL HYDROQUINONE SODIUM SULPHITE POTASSIUM BROMIDE.
EFFECT OF VARYING QUANTITIES OF CHEMICALS UPON DEVELOPMENT.



BOOK REVIEWS

THE MIRACLE OF THE MOVIES, by Leslie Wood. 352 pp. (Burke Publishing Co., 15s.)

The author of this book has long been a familiar figure in Wardour Street; before Wardour Street became the home of the film trade he had worked in many branches of the then young industry. Although the book is written primarily for the layman, the technician will find it of absorbing interest.

Starting with some introductory chapters describing the making of a film, the author traces the history of cinematography right from the early researches into persistence of vision up to the present day.

It would be interesting to have documentation for the anecdotes recounted of Lumière and Edison, which indicate that neither had much faith in the future of the film. Friese-Greene's confidence in its potentialities is in striking contrast; his life and work are sympathetically although not uncritically discussed, while due credit is given to Robert W. Paul. Edison's contribution is on the other hand much belittled.

Of Hepworth, Barker, Cricks and Martin, Clarendon, the author writes from personal knowledge. The story turns to America: the patents war—the contributions of

D. W. Griffith—the advance of the American trade during the first world war. The ephemeral revival of the British industry in the 1920s is described—the setback it received on the advent of sound—finally, the inspiration of the second world war which enabled our producers once again to challenge Hollywood.

The only criticism on a matter of fact is that John Maxwell was associated with A.B.C., not with G.B.

The many excellent stills enhance the value of an admirable book. R. H. CRICKS.

BRITISH JOURNAL PHOTOGRAPHIC ALMANAC, 1948. 492 pp. plus photographure supplement. (H. Greenwood & Co., Ltd., 5s., in cloth 6s.)

In so far as photography is an essential part of cinematography, the *B. J. Almanac* is an essential work of reference to the cinematographer.

An article of particular interest cameraman deals with visual filters. Bowler contributes a useful article on the film strip.

There are the usual innumerable technical tables, while the advertisement pages indicate a remarkable progress in the development of apparatus.

JOINT MEETING WITH A.C.T.

At the joint meeting with the Association of Cine-Technicians, to be held at the G.B. Theatre on Wednesday, April 28th, at 7.15 p.m., a discussion will take place between Sir Henry French, G.B.E., K.C.B., Director General of the British Film Producers' Association, and Ralph Bond, of World-Wide Pictures, under the title,

"A Survey of the British Film Production Industry."

The meeting will, as already announced to Members, be preceded by the Ordinary Meeting of the Society, to be held at 6 p.m. in the Small Theatre, Film House, Wardour Street, W.1.

VISIT TO M.G.M. STUDIOS

By courtesy of Messrs. Metro-Goldwyn-Mayer British Studios, Ltd., the Film Production Division has arranged a visit to the Company's studios at Boreham Wood—one of the best equipped studios in the country.

From 10.45 a.m. parties will be conducted round the studios; luncheon will be served at 1 p.m. Numbers are strictly limited, and admission will be by ticket only, in the

allocation of which preference will be given to Members, Associates, and Students of the Society; if numbers permit, guests may be invited.

It has unfortunately proved impossible to hold the exhibition of equipment which it had been proposed to arrange for the afternoon. Manufacturers who have been approached are asked to accept this notice as intimation of the cancellation.

EXHIBITION OF BRITISH FILM ART

An exhibition of the work of the art director is being held at the Victoria and Albert Museum (Rooms 70, 71, 72, and 73) until May 15th. The work of practically every British art director is represented,

in the form of sketches, drawings, and plans.

The exhibition is open from 10 a.m. to 6 p.m. weekdays, and 2.30 to 6 p.m. on Sundays. Admission is free.

THE COUNCIL

Meeting of March 3rd, 1948

Present : Messrs. I. D. Wratten (*President*), W. M. Harcourt (*Vice-President*), E. Oram (*Hon. Secretary*), C. H. Champion, R. B. Hartley, B. Honri, L. Knopp, A. W. Watkins, A. G. D. West (*Past President*), R. Pulman (*representing Theatre Division*), H. S. Hind (*representing Sub-standard Division*), G. Burgess (*representing Film Production Division*) and R. H. Cricks (*Secretary*).

Finance Committee.—Budget for the year's expenditure was submitted, and proposals for reducing the cost of meetings were approved.

Secretaryship.—On the proposal of the Finance Committee, it was agreed to appoint a full-time Secretary, responsible for the administration of the Society's affairs. Mr. Cricks would act as editor of *British Kinematography*, and as Technical Consultant to the Society on a part-time basis.

Premises.—In view of a considerable increase demanded in the rent of the Society's premises, the possibility of alternative accommodation was considered.

Annual Elections.—The position of nominations in the annual election of Officers and Council was reported.

Deputy Vice-President.—A previous proposal that a Deputy Vice-President be appointed was re-considered and confirmed.

Co-operation with S.M.P.E.—Matters arising out of the plan of co-operation with the S.M.P.E. were considered. It was agreed to send a cable wishing success to the Society's half-yearly Convention.

Anglo-American Standards Co-operation.—Representation of the S.M.P.E. on committees of the B.S.I., and of the B.K.S. on American standards committees, was considered.

Representation on B.S.I. Committees.—Representatives of the B.K.S. were appointed to a number of B.S.I. technical committees.

Film Mutilation Brochure.—Arrangements for the issue, in conjunction with the C.E.A. and K.R.S., of brochures on film mutilation, were reported to be progressing satisfactorily.

Library.—It was agreed to send a letter of thanks to Mr. Marcus Cooper for the film on the library which he had kindly made and presented to the Society.

Home Office Regulations.—Proposed revisions to the draft regulations under the Cinematograph Act were reported to be under consideration.

Provincial Sections.—Meeting of members at Leeds was reported, at which the formation of a branch had been discussed. It was also reported that a meeting had been convened at Glasgow. It was agreed that the matter of Branches and Sections should be fully considered by the Council at its next meeting.

Sub-standard Film Division.—It was reported that the Committee had already commenced work on its next session's lecture programme.

Film Production Division.—A sub-committee had been appointed to make arrangements for the meeting of May 8th.

Training and Apprenticeship Council.—It was reported that the Society was to be represented at a meeting of the Council's Education Committee on March 17th.

EXECUTIVE COMMITTEE

Meeting of March 3rd, 1948

Present : Messrs. I. D. Wratten (*President*), W. M. Harcourt (*Vice-President*), E. Oram (*Hon. Secretary*), R. H. Cricks (*Secretary*), and Miss S. M. Barlow (*Assistant Secretary*).

Elections.—The following were elected :

ALFRED WILLIAM LUMKIN (Associate), Alliance Film Studios.

WALTON THOMAS RUDD (Member), Admiralty Signal and Radar Establishment.

BERTRAM VIVIAN BOWDEN (Member), Sir Robert Watson-Watt & Partners.

KENNYTH ERNEST HARRIS (Member), Sir Robert Watson-Watt & Partners.

WALTER BADEN DEAN (Member), Brookfield Kinema, Poynton.

CHARLES HILARY WATSON (Associate), Abbey Entertainments, Ltd., Leeds.

RODERICK GEORGE BARNBROOK (Associate), Ascot Theatre, Glasgow.

PERCY RALPHS (Member), Pinewood Studios.

WILLIAM STANLEY GRANT (Member), Pinewood Studios.

REGINALD E. F. WRIGHTSON (Member), General Electric Co.

JOHN FRANCIS COLLYER (Member), General Electric Co.

VIVIAN NEVILLE WARWICK (Associate), Marcus Cooper, Ltd.
 ARTHUR VALENTINE ELSEY (Associate), Pinewood Studios.
 JAMES W. L. DE G. HARRIS (Associate), New Zealand National Film Unit.
 GEORGE MAUGHAN HALL (Associate), Rex Theatre, Murton, Co. Durham.
 DORREN EILEEN PATRICIA COX (Associate), Hippodrome, Middlesbrough.
 VERA RUSSELL-GREEN (Student), Harrow Technical School.
 WILLIAM JOHN RAYMONT (Member), Cinetra Mfg. Co., Ltd.
 BERNARD RANDOLPH GREENHEAD (Member), E.M.I. Research Laboratories.

Transfers.—The following Associates were transferred to Corporate Membership :
 SIMON DIMMOCK ONIONS, Cameraman.

THOMAS A. BURROWES, Twenty Century-Fox Film Co., Glasgow.

RONALD H. RILEY, Verity Films, Ltd.

ALFRED FREDERICK CARRINGTON, G.B.-Kalee, Ltd.

The following Student was transferred to the Associateship :

WALTER RAYMOND WINGATE, Pathé Pictures, Ltd.

Resignations.—The following resignations were accepted with regret :

HAROLD GALE (Associate).

GEORGE DOBSON (Member).

PERSONAL NEWS of MEMBERS

Members are urged to keep their fellow members conversant with their activities through the medium of British Kinematography.

ALFRED BROWN has resigned from the management of G.B.-Kalee Newcastle-on-Tyne Branch.

CHARLES H. CHAMPION has had to undergo a further operation, but is now making satisfactory progress.

H. G. DINES has joined the B.B.C. Film Unit, and is engaged in the production of newsreels for television.

E. GARDINER has been transferred to the Odeon, Uxbridge, as chief projectionist.

C. G. HEYS HALLETT has returned from a visit to Hollywood.

J. G. NOWELL, a former Polytechnic student, has on his release from the mines, obtained an appointment with the Manchester Film Studios.

R. NUTTALL, when a student at the Polytechnic, made a 16 mm. film with synchronised disc, dealing with mining ; the film has now been acquired by the National Coal Board.

GEORGE SEWELL, who is directing in Africa for the Colonial Film Unit, has visited Kenya, Tanganyika, Uganda, Gambia, and Sierra Leone.

WANTED TO COMPLETE SET. Back numbers of the Journal : Vol. 6, No. 4 ; Vol. 7, No. 1. Back numbers of the Proceedings : 1, 22, 23, 28, 29. Apply—Librarian, Information Department, British Film Institute, 164, Shaftesbury Avenue, W.C.2.

BRITISH KINEMATOGRAPH SOCIETY

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Members, Associates and Students are entitled to attend meetings. Only Members are entitled to hold office or to vote.

The journal of the Society, *British Kinematography*, is supplied free of charge to Members and Associates ; subscription to Students 10s. per annum (otherwise 36s. per annum).

Proposal form on application from the Secretary

Journal of the BRITISH KINEMATOGRAPH SOCIETY

Copies of most of the back issues of the *Journal* are available, price 5s. 3d. post free (since July, 1947, 3s. 2d.)

Proceedings of the BRITISH KINEMATOGRAPH SOCIETY

Prior to the inauguration of the *Journal*, papers read to the Society were reprinted in *B.K.S. Proceedings*. Nearly complete sets (1931 to 1936) are available price 10s., post free.

DIVISIONAL PROCEEDINGS

The following Proceedings of the Divisions of the Society have been published, price 5s. 3d. each post free :

Theatre Division, 1944/45.

Theatre Division, 1945/46.

Sub-standard Film Division, 1944/45.

Film Production Division, 1945/46.



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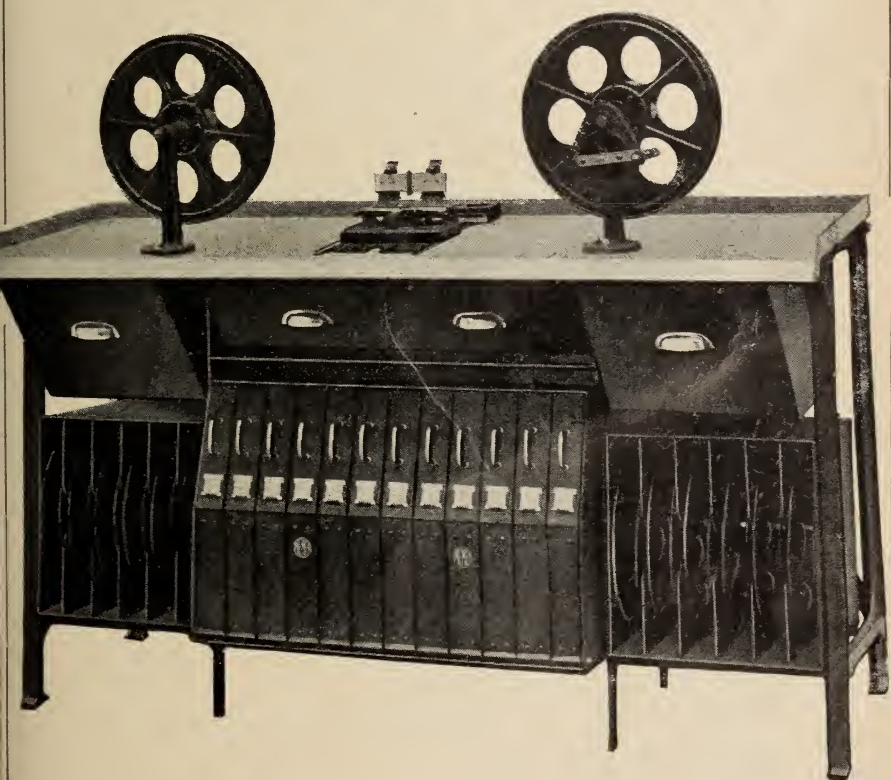
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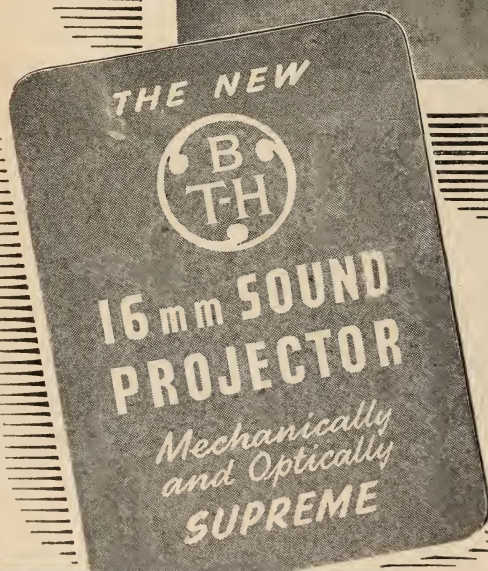
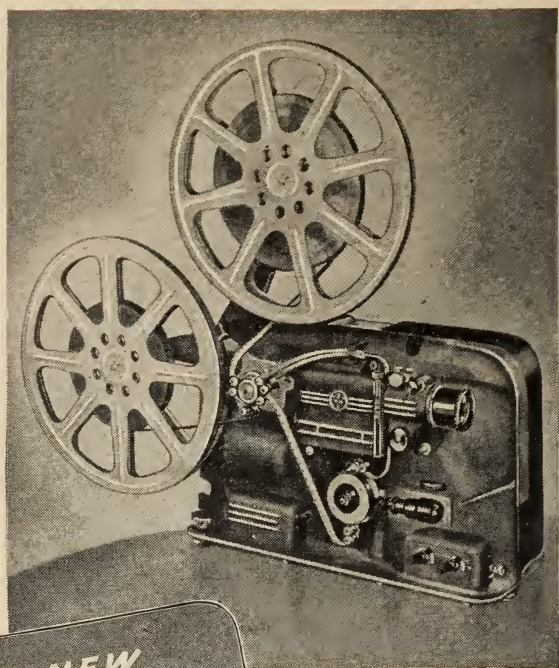
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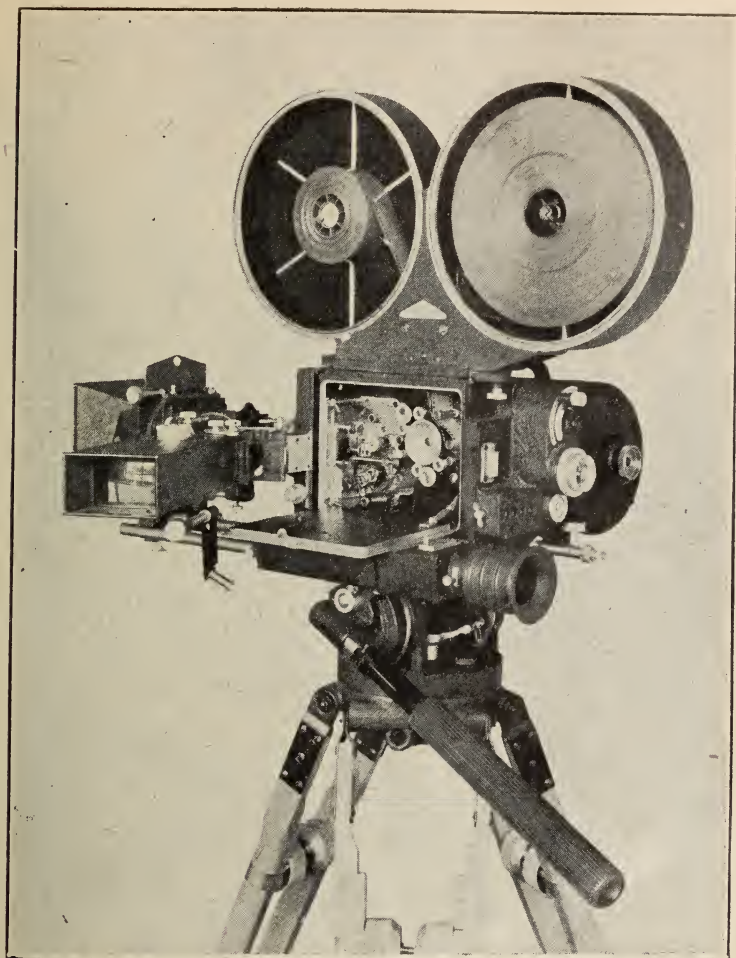
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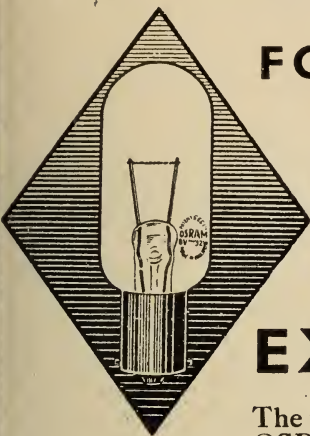


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The Journal of the British Kinematograph Society

VOLUME TWELVE, No. 5.

MAY, 1948

OFFICERS and COUNCIL



1948—

1949

WILLIAM MICHAEL HARCOURT—President

Mr. Harcourt entered the film industry in 1918, first in laboratory work and later as cameraman. He enjoyed a very wide experience in many phases of cinematography, both in the States and abroad on several expeditions. These expeditions took him to remote parts of the world, including Tibet (which country he was one of the first cameramen to enter), the South Sea Islands, South America and Central Africa. His studio experience included the Paramount Studios at Long Island. He

changed his sphere of interest to that of newsreels in 1929 when he joined Paramount News as make-up editor.

In 1936 he became Assistant General Manager to the newly opened Denham Laboratories, of which he is now Managing Director. Soon after the cessation of hostilities he visited Germany on behalf of the Foreign Office to make a survey of what remained of the motion picture industry, and has also made repeated visits to the Continent, the United States and Canada on behalf of his Company.

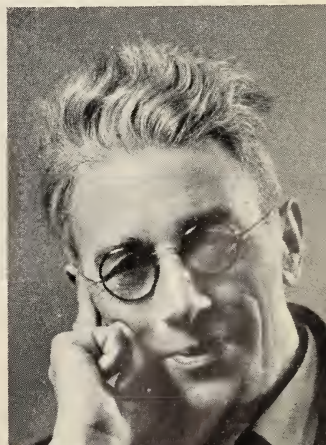
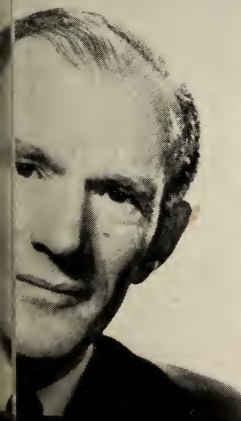
In 1945 he was elected a Fellow of the Royal Photographic Society. He was also one of the original fifteen Fellows of the British Kinematograph Society, elected in 1946.

Mr. Harcourt is the fourth President of the Society, his predecessors being Mr. Simon Rowson, Mr. A. G. D. West, and Mr. I. D. Wratten, the last of whom becomes *ex officio* a member of Council.

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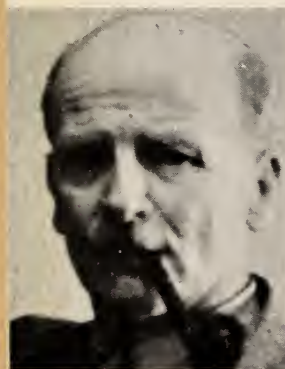


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SOUND-ON-FILM REPRODUCING EQUIPMENT

Read to the B.K.S. Theatre Division on May 18th, 1947.

I.—THE SOUND HEAD

A. T. Sinclair, A.M.I.E.E., M.B.K.S.*

THE basic requirements of the sound head are fixed, first by the characteristics of the sound track¹, secondly by the demands of reproduction quality.

Although the human ear is not very good at assessing *absolute* pitch, it is extremely sensitive to small *differences* in pitch, particularly when the sounds are presented either simultaneously or in quick succession. For instance, a variation in pitch of $\frac{1}{4}$ of 1% in a pure 2000 cycle tone, 60 times per minute, can readily be detected², whilst errors of pitch as small as 5 parts in 100,000 have been identified at a lower repetition rate³. (Fig. 1.) Under practical conditions, the maximum flutter or temporary deviation from mean speed should not exceed 0.15% and this figure is recommended by the Academy of Motion Picture Arts and Sciences⁴.

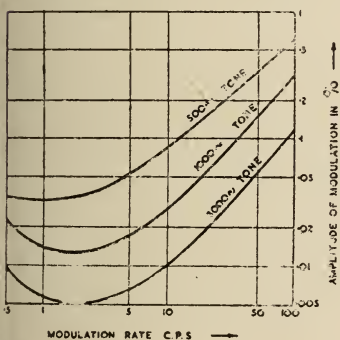


Fig. 1. Threshold of Audibility of flutter of 500, 1,000, and 3,000 c.p.s. tones, modulated at various Rates and at various Amplitudes.

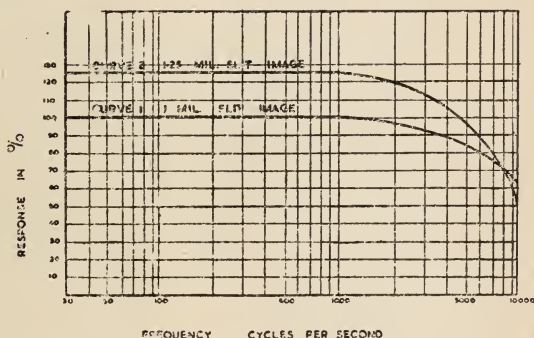


Fig. 2. Loss of Output due to Finite Width of Scanning Slit.

The loss of output at the higher frequencies resulting from scanning beams of various widths is shown in Fig. 2. A part, at least, of the loss due to the finite size of the slit may be recovered—if desired—by electrical compensation in the amplifier.

Whatever size of slit is used, it is imperative that its orientation with respect to the direction of travel of the track shall be the same as that of the slit in the recording camera, otherwise considerable harmonic distortion will be introduced in the reproduction, as well as some loss in output⁵. In practice, this means that the scanning slit must be perpendicular to the track within a tolerance of about $\frac{1}{4}$ degree.

Having established some of the important characteristics of sound film reproduction, let us consider the means whereby such sound records can be effectively reproduced, and attempt to review the various ways by which the rather stringent technical requirements have been met.

Driving Means

Since accurate film speed is so much more important to sound reproduction than to picture presentation, it became the recognised practice, at an early

date, to consider the driving motor as a part of the sound equipment, though in point of power demand, the picture projector represents at least three-quarters of the total load on this motor.

When sound-pictures were first introduced, rather special kinds of constant speed motors were deemed necessary, but entirely satisfactory performance can now be obtained from conventional single-phase induction motors. Split phase, capacitor or repulsion starting arrangements may be successfully used, provided that the starting torque and acceleration characteristics are properly matched to the static load and to the rotational inertia of the sound head and projector. To comply with Academy recommendations, the film should reach full speed from rest in 2-3 seconds⁶.

As the usual 4-picture film sprocket must rotate at 360 r.p.m. to provide a film speed of 90 ft./min., it is necessary to introduce some speed reduction device between the motor spindle and the sprocket shafts. Thus in early equipments the motor was frequently mounted on the projector pedestal and coupled to the soundhead by a chain, belt or complicated gearing. Such arrangements have given way almost entirely to designs in which the motor is an integral part of the soundhead and drives the sprocket shafts via simple gearing or by a short chain or V-belt. Resilient mounting of the motor is customary, as it reduces the transmission of mechanical vibration and magnetic hum to the film scanning parts.

Provision must also be made in this part of the mechanism for driving the picture projector and the lower spool box. In this connection, the designer's job is made extremely difficult by the wide variety in speed and position of the drive shafts and the different mounting arrangements adopted by the various projector manufacturers. In past years, some very complicated arrangements of gears, brackets and chains have provided the only possible means of making certain "adaptations." The position now is not much better, and it is a matter for regret that the industry has not taken some positive steps towards international standardisation of these projector characteristics—if only to facilitate the sale of English projectors overseas.

Constant Speed Drive

A properly engineered arrangement of an induction motor and speed reducer will provide at the sprocket shafts what may be termed "commercial" constant speed. However, slight mechanical imperfection in gears, bearings and film sprockets, and particularly the engagement of the sprocket teeth with the film perforations, may impart speed fluctuations to the film sufficiently large to be detected as flutter.

It is obviously necessary that the sound track must be guided very accurately past the scanning light, and it was not unnatural that the earliest sound gates were little more than small versions of the picture gate. It was soon realised, however, that the frictional drag imposed on the film by this type of gate accentuated the effect of sprocket tooth ripple, whilst random changes in the film tension promoted low period speed fluctuations.

About 1932 a greatly improved film scanner was introduced to the industry in the form of a freely rotating drum type film support, coupled to a damped flywheel, and with some detail differences, this basic arrangement is used today by all of the leading manufacturers⁷.

Once the flywheel has been brought up to speed, very little film pull is required to keep it rotating and hence, by appropriate placement of the sprocket relative to the drum, the film is caused to assume an "S" shaped path by virtue of its inherent stiffness. The consequent resilience of the film effectively prevents the transmission of high frequency disturbances along its length, whilst the flywheel minimises the low period fluctuations.

Flywheel Damping

The method of providing the flywheel damping is all important, since any method which imposes a steady drag will, by increasing the film load, tend to eliminate the loose "S" loop and so degrade the filtering performance. This means that, in practice, the damping must be effected between the flywheel and some additional component revolving at about the same speed.

Thus by using a copper flywheel in conjunction with an independently driven group of magnets, the eddy currents induced in the flywheel, when its speed differs from that of the magnets, produce a friction drag between the two parts. A similar effect can be obtained by using the viscous drag of an oil film between the two members.

However, a relatively "tight" coupling between driving and driven members is required to suppress satisfactorily the tendency to oscillate, and in consequence, any speed variation of the independent driving member tends to be transferred to the film drum. To avoid this new potential source of speed fluctuation, it may be necessary to adopt elaborate means of mounting and rotating the controlling member.

A somewhat simpler solution is offered by the so-called "rotary stabiliser," wherein the desired damping takes place between the film-driven outer shell and the free running inner flywheel, through the medium of a viscous fluid which fills the small clearance between the two parts. In an alter-



Fig. 3. Compliance of Film Loop.

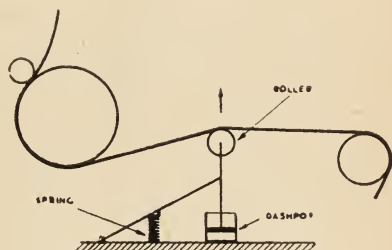


Fig. 4. Loaded Film Loop.

native design, the inner solid flywheel is replaced by a heavy liquid of low viscosity, which has to force its way through narrow channels within the shell. The resulting viscous resistance provides a degree of damping quite similar to that of the previously described type⁴.

Film Compliance

The successful elimination of high frequency flutter, and particularly the 96 c.p.s. tooth ripple, depends largely on the compliance of the loop of film between the drum and the sprocket, and this is governed by the bending stiffness of the film, the tension in the film, and the relative diameters and placement of the drum and sprocket. Obviously the compliance will be least when the film is under such tension that it follows a straight path from sprocket to scanning drum (Fig. 3).

Film stiffness is known to vary according to the thickness and age of the stock and the humidity of the atmosphere, whilst the film tension depends, in most designs, on the friction in the bearings of the scanning drum. In practice, there has been little indication that these variable factors have any noticeable effect on operation, but the performance may be made independent of these variables by providing a spring loaded and damped roller to bear on the film between the sprocket and the drum, as shown in Fig. 4.

Optical System

Turning now to the optical parts of the soundhead, the scanning of the sound track is performed either in the plane of the film, or on a projected image of the sound track.

In order that light may pass through the sound track, one side of the film must overhang the edge of the scanning drum. This "overhang" must be kept as small as possible, with the result that it is necessary to put a "twist" in the light path to avoid interception by the opposite edge of the drum. It is usual, therefore, to support, within the hollow end of the drum, a prism assembly, which diverts the light beam away from the drum towards the photo-cell, and in some designs, two or more prisms are employed, as shown in Fig. 5.

In most cases, achromatic optical systems are employed. As an alternative, a filter may be inserted to limit the wave band of the transmitted light, provided that the cell employed has adequate sensitivity within the selected colour range.

Since the drum type of scanner requires a roller to keep the film in contact with the drum surface, it is usual to make this roller control the lateral position of the film by the simple expedient of fitting it with flanges. Precise

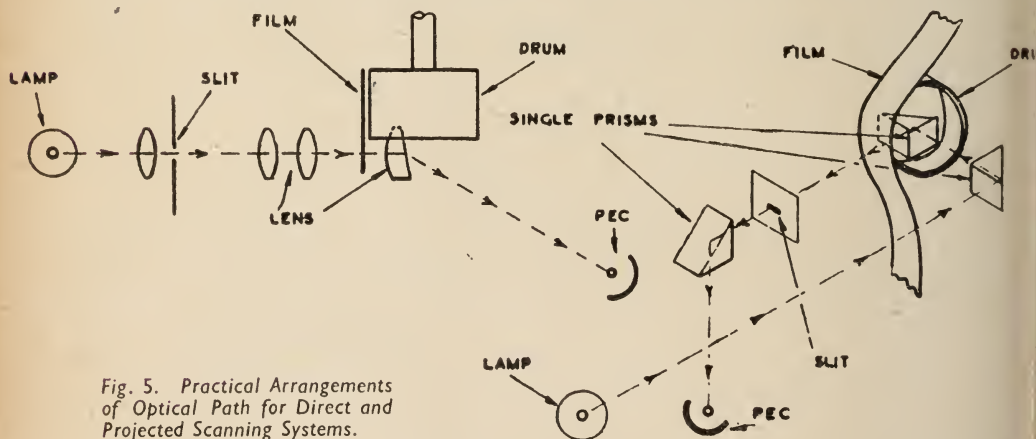


Fig. 5. Practical Arrangements of Optical Path for Direct and Projected Scanning Systems.

adjustment is effected by moving the roller supporting arm along its spindle by a knurled nut or equivalent device, and in some instances the nut is provided with markings to facilitate temporary resetting of the film position to compensate for a misplaced sound track.

Parasitic Noise

System noise may be caused by spurious modulation of the scanning beam, excitation of the cell by stray light, and microphonic pick-up by components in the signal circuit.

The undesirable modulation is generally due to relative movement of the elements of the optical train by projector vibration, and to minimise this trouble it is usual practice to mount rigidly together on a sub-frame the scanning drum, guide roller, optical system, photo-cell and exciter lamp, and to isolate this assembly from the main soundhead case by resilient pads.

The second cause of noise is overcome by so enclosing the cell that it is screened from all stray light from the exciter lamp or any other source, whilst microphonic pick-up is minimised by cushion mounting the cell transformer or head amplifier.

It has been suggested that some of the difficulties associated with the low

signal level from conventional photo-cells might be overcome by using the electron-multiplier type of cell, but so far as we are aware, no commercial sound film installation using this device has yet been made. In the near future, however, the industry may be obliged to use photo-cells which have a different colour sensitivity to those now in use, in order to reproduce satisfactorily certain types of colour films. These films have a dye-image sound track which is relatively transparent to the red part of the light from the exciter lamp, and to obtain good results it seems probable that cells will have to be used which are sensitive only in the blue light region. Field trials of the new cells are already under way in the States⁸.

II.—ELECTRICAL, ELECTRONIC, AND ACOUSTIC DESIGN

H. J. O'Dell, A.M.I.E.E., M.B.K.S.*

IN order to maintain a continuous performance, two soundheads are necessary and there is a number of methods in use for transferring sound reproduction from the outgoing to the incoming projector.

Change-over Requirements

The basic requirements are :—

- The transfer of sound should be practically instantaneous.
- Two control positions, one adjacent to each machine, are desirable.
- The switch circuits should be reliable and noiseless.
- Associated with the change-over device there should be means for obtaining equal average signal levels from the soundheads.

One of the earliest arrangements was a fader potentiometer connected to the photo-cell transformers and operated manually. At a later date various arrangements of relays were used, but these are rather susceptible to hum pick-up and noise, especially under damp conditions. Various arrangements of selector switch are also in use, usually having some form of mechanical coupling to an extension position.

A later refinement which met with considerable success used high grade mercury switches arranged as in Fig. 6. The three mercury switches are mounted in a control unit, mechanically coupled to an extension position, and can be manually rotated so as to tilt the combination of switches into the desired position. Such a design is costly but reliable, and since there are no exposed electrical contacts a minimum of service work is necessary.

At present there is a general desire to conserve the life of exciter lamps, and sound change-over by extinguishing the exciter lamp on the outgoing machine and simultaneously energising the lamp on the incoming machine has become fairly generally adopted. The lamps are in series across the supply, and the switch circuit shunts the "pre-heat" resistor across the lamp in the idle soundhead, thus practically extinguishing it. The advantage of the "pre-heat" resistor is to minimise the short delay which occurs in bringing the incoming lamp up to full brilliance, and in practice the momentary reduction in exciter lamp illumination during change-over has no adverse effect on the sound reproduction.

*RCA Photophone, Ltd.

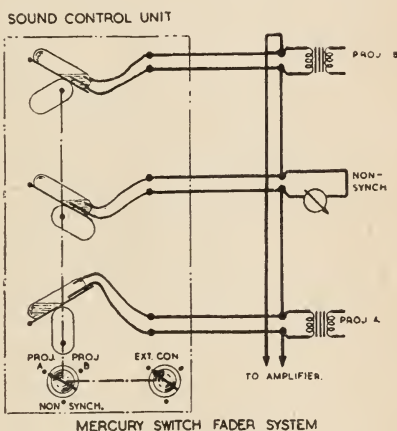


Fig. 6. Change-over Arrangement employing Mercury Switches.

The Pre-amplifier

It is usual to adjust the level of the signal from the two soundheads to an equal average amount by varying the photo-cell polarising voltage. This adjustment is made by running a 1000-cycle film loop simultaneously in each soundhead, and using an output meter to establish equal output levels.

A pre-amplifier is frequently built into each soundhead, but the close proximity between the mechanical portion of the soundhead and the pre-amplifier calls for special precautions in the method of mounting and shielding. A compromise is to design the pre-amplifiers for wall mounting, adjacent to their respective soundheads, to which they can be coupled by short lengths of low-capacity cable. The use of an individual volume control and fader switch built into each pre-amplifier is convenient for the projectionist.

Amplifier Requirements

For small theatres the complete amplifier with built-in monitor speaker can be contained in a wall-mounted cabinet, located between the two projectors. For larger kinemas a group of rack-mounted amplifier units is usually provided.

Unit specialisation of amplifier equipment can be considered under three headings :—

1. Audio frequency performance requirements.
2. Electro-mechanical design in relation to operation and maintenance.
3. Emergency operation features.

In considering the first point we should review briefly the standards which are generally established in present day amplifier practice :

1. The input-output characteristic must be linear within close limits up to the maximum rated power output.
2. The overall amplification must be adequate so that with 100% modulation it is possible to develop the full rated power output even under exceptional film conditions which may restrict the photo-cell signal to an unusually low level.
3. The audio-frequency response characteristic should be consistent with modern recording, which extends from 40 to say 8,500 cycles. Moreover, the amplifier should embody simple means for adjusting the frequency response if necessary to suit abnormal auditorium conditions.
4. The power output must be in accordance with the size of the kinema^a, also it should be equally good at all frequencies within the range selected for reproduction.
5. The amplifier must be capable of good reproduction of transient sound waves, also negligible phase shift is desirable.

It is possible to meet all these requirements in the amplifier system by proper choice of valves and components, and by the application of inverse feedback in the circuit design.

Volume Control

Turning now to general design, it is important to note ways in which separate units can be grouped to give convenient operating features and developments in chassis design which facilitate service work in an emergency.

An important point as regards operation is convenient location of the volume control. Where pre-amplifiers adjacent to or in each soundhead are used, a conventional grid potentiometer control in the second stage of the pre-amplifier is a convenient arrangement. Another method is to use a cathode-follower stage in the pre-amplifiers in order to obtain a low-output impedance, and to come into an attenuator before passing the signal to the power amplifier rack.

The amplifier rack is usually a short distance from the projectors, and :

volume control on the rack itself has disadvantages, as it is not so readily accessible to the projectionist. The present-day tendency therefore is to bring the volume control to a position on the front wall by suitable design of the amplifier circuit. One method of doing this is to include an attenuator in the circuit between the pre-amplifier and power amplifier.

Early type amplifier units were necessarily bulky, but development of high gain valves, electrolytic capacitors, and the use of resistance-capacity coupling and phase-inversion circuits has given us more compact designs. Panel-type units, some with hinged chassis, have been developed permitting a rapid inspection of interior wiring and components.

Stand-by Amplifier

As regards our third point, emergency operation, a typical arrangement of units provides complete duplication of the amplifier system. Duplication as an insurance against electronic trouble is worth while in certain important kinemas, and there will always be a demand for this feature.

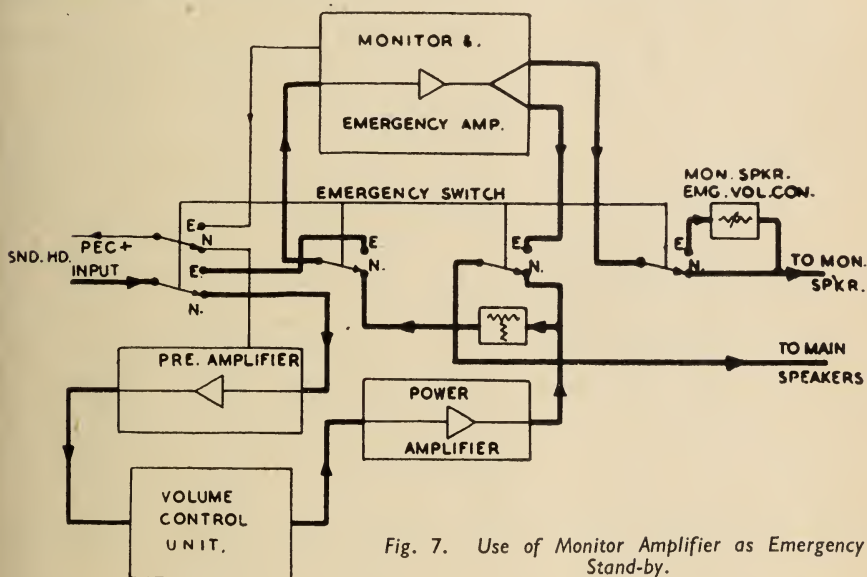


Fig. 7. Use of Monitor Amplifier as Emergency Stand-by.

There is much to be said, however, for an alternative policy, whereby the group of amplifier units embodies what may be described as emergency operation features. For example, provision may be made to switch the voltage amplifier direct to the loudspeaker system in the event of breakdown of the power amplifier; its output of 4 or 5 watts is sufficient to keep the performance running satisfactorily. This arrangement covers one of the most likely contingencies, namely, failure of a power valve or rectifier valve.

A more recent design is shown in Fig. 7. Here, in the event of failure of the main amplifier channel or the associated volume control, the emergency switch can be used to transfer operation to the monitor-emergency amplifier. This is an independent self-contained unit capable of 15 watts audio output, and normally used for monitoring purposes only. An auxiliary volume control for the monitor speaker is switched into operation by the emergency control panel.

Loudspeaker Design

The specialised unit which remains to be considered is the loudspeaker system, and for many years now the so called two-way system has been used.

The amplifier output is divided into two sections, usually at 400 cycles, by an electrical filter network, and transmitted to a folded type of low-frequency baffle energised by one or more loudspeakers in combination with a multi-cellular exponential horn coupled by a suitable throat unit, to one or two high frequency loudspeakers. It is perhaps on the design and standard of construction of the latter that high-fidelity reproduction depends today more than any other factor in the sound reproducing system, since loudspeakers, if of poor quality, are capable of introducing harmonic distortion in excess of anything developed in the amplifier itself¹⁰.

In the past energised fields have been used, but with recent improvements in permanent-magnet steels it has been possible to obtain equally good results using these materials. The use of permanent magnet loudspeakers increases overall equipment reliability and reduces wiring and maintenance costs. Most types of high-frequency loudspeaker use a light small diameter

Fig. 8. Lansing "Duplex" Loudspeaker Unit.

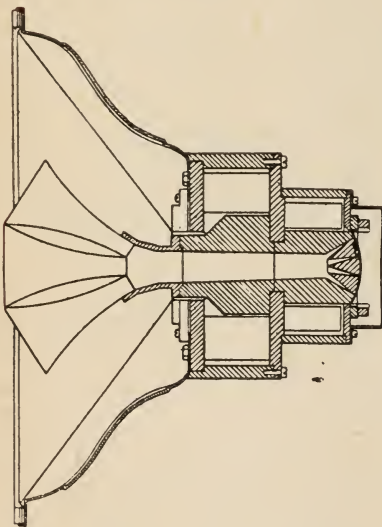
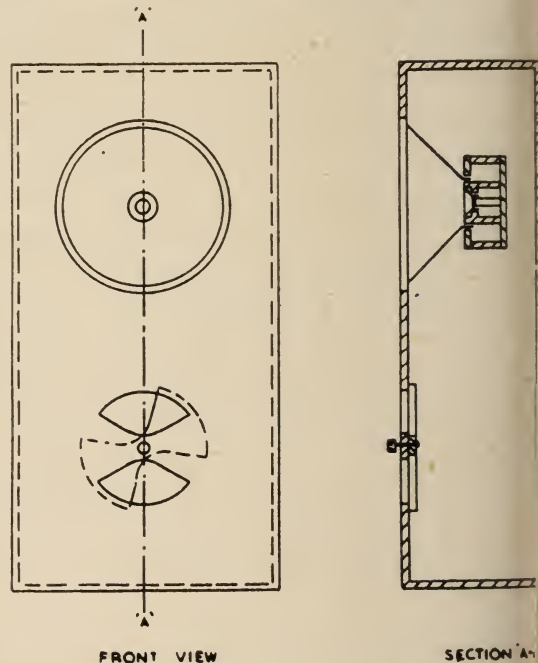


Fig. 9. RCA "Duo-cone" Direct Radiator Loudspeaker.



cone or dished diaphragm made of aluminium alloy or bakelised linen, and have a relatively large diameter voice coil wound with aluminium wire or strip. The diaphragm is coupled to the horn by a multi-aperture throat designed to transmit acoustic energy from all zones of the diaphragm surface with the minimum of loss due to interference effects.

New types of loudspeaker unit have been developed in recent years, such as the Lansing "Duplex" unit¹¹ (Fig. 8) and the RCA Duo-cone direct radiator loudspeaker¹² (Fig. 9). The latter, it will be noted, has a phase inverter type cabinet whereby the sound wave from the rear surface of the low-frequency cone emerges through a variable port, and by proper choice of dimensions this device improves the response at low frequencies.

These types, however, are not suitable for kinemas, where, from a consideration of the acoustic conditions, it is desirable to use a horn with a directional characteristic to suit the shape and dimensions of the auditorium. In general the special types of loudspeaker mentioned radiate over too great

an angle and are therefore more suited to studio monitoring applications where acoustic conditions are good.

Future Developments

Prior to the war there were several special developments in sound reproducing equipment. Push-pull sound tracks were introduced, but so far have only found general acceptance in this country in studios for original recordings. Stereophonic systems have received considerable attention in the U.S.A. The Disney feature production "Fantasia" was accompanied by the development of a multi-track sound reproducing system including the use of a control track by means of which the volume range was extended 30-40 db. and controlled automatically during the showing of the film.

Further work on the use of relatively simple control tracks for the same purpose is in progress, and it seems possible that equipment having a greater volume range than the present 45-50 db. could be made available to the industry without much difficulty.

The greatest single limitation to better reproduction which we still face in many of our existing kinemas is unfavourable acoustic conditions, and there is immense scope for the application of corrective measures, in order to do full justice to the high standard of which a modern system is capable.

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DISCUSSION

Mr. R. H. HOLLYMAN : Has Mr. Sinclair any personal preference for the system of scanning—direct or indirect?

Mr. SINCLAIR : I have no personal preference. I believe on technical grounds either system can be equally effective.

Mr. R. H. HOLLYMAN : I have had a great deal of experience on different equipments, and in general I prefer the projected image system.

Mr. R. H. CRICKS : We hear manufacturers claiming .0005 in. slits, or even less, on an emulsion .001 in. thick. Is it not better optically to project the track and then scan it, rather than to try to produce such a narrow image?

Mr. SINCLAIR : Given equal design, and given equal quality of manufacture in the optical parts, I do not think there is much to choose between the two systems. It is possible that the projected system has some advantage, but it would be mainly in ease of adjustment rather than in the actual results obtained.

Mr. R. H. HOLLYMAN : Does not the question of light scatter arise more with the projected slit system?

Mr. SINCLAIR : Light scatter is undoubtedly a problem, but you must remember in the projected track system, not only is the image of the sound track enlarged, but also the slit is proportionately larger.

A VISITOR : Is it possible to modify the L.F. speaker housing in such a manner as to increase the L.F. efficiency?

Mr. O'DELL : The important thing to realise is that to increase the efficiency of the L.F. acoustic output, you must try to utilise the back wave as well as the front wave. Since these signals are alternating, it is obvious that you must superpose them so that they emerge in phase. It is for that reason that there is a limit to what you can do by that method, not only in improving efficiency, but there is a limit to the range of frequencies over which the idea is effective.

TELEVISION PRODUCTION IN CONTRAST TO FILM PRODUCTION

Philip H. Dorté, O.B.E., A.M.I.E.E.*

Read to the B.K.S. Film Production Division on November 5th, 1947.

TELEVISION has been likened to the daily newspaper, and the motion picture to the weekly magazine, printed on good paper, with coloured illustrations. The simile is apt, because the film producer can take the time to put into his production the polish which is always evident in a really well produced magazine—in other words, he can afford to spend a whole day on the floor shooting some two to three minutes of final screen time; the television producer on the other hand has, in a day's work on the floor, to produce two to three *hours* of screen time, and it must be quite obvious from this that his result must, in comparison with the product of the film studio, be sometimes less polished, even though, because of the immediacy of television, it can on occasions be more exciting.

The B.B.C. Television Service, whose output is, incidentally, very considerably greater than that of any other individual television broadcasting system in the world, broadcasts some 30 hours of screen time per week, of which some 24 hours consist of "live" material—the balance being film. This weekly 24 hours of "live" screen time comes from two very small stages and from two outside broadcasts units.

Television in Film Production

The film producer who even now visualises the day when it will be possible for his actual shooting-schedule to be hours instead of months is not, in fact, making a quite fantastic suggestion. If and when the research laboratories of the electronic and film-stock industries can jointly produce a worthwhile system whereby a high-definition three-colour television picture can be recorded, complete with sound, directly on to film, that day will have arrived; for then it will be practical for his cast to come on the floor word and action perfect and prepared to play the whole script right through, whilst the director—his work already largely done in the rehearsal-room—can sit in the control-room and direct not only the camera operation but also the cuts, dissolves, wipes and fades that separate and link his shots and sequences. In other words, the film director will be doing just what the television producer is doing now.

To forestall any accusation that in this eventual film-studio Utopia the standard of film production would be lowered to that of television broadcasting production, I would point out that the film director would still be able to say "Cut" during any stage of shooting, and could still have retakes of a given sequence. In the television broadcasting vocabulary, on the other hand, the words "cut" and "take two" just do not exist; once a programme has started—and it must, of course, start at the advertised time—it must go on to the bitter end, no matter how many errors, human, electrical or mechanical, intervene.

"Live" Transmission versus Film

Why does the television broadcasting producer not film his programmes in advance and thus not only ensure the broadcasting of a more polished performance, but so also present himself with the means of repeating them

*Television Outside Broadcasts and Film Supervisor, British Broadcasting Corporation

at will? Film technicians are frequently unsympathetic to my view, which is that it would be psychologically wrong and economically unsound.

The theatre excepted, television broadcasting is the most intimate medium of entertainment yet devised by man, and there is unquestionably a very strong bond between the performer in the studio and the viewer in his home. Insert celluloid between them so that the viewer is watching not the performance of a living actor *now*, but a reproduction of his performance of a few days ago—and the bond is cut; the actor is no longer playing expressly for the benefit of each and every individual viewer; the link which always ties the stage-actor to his audience is missing; the “personal appearance” atmosphere is gone.

Financial considerations bring one to the same conclusion—at any rate in Great Britain; omitting standard overheads in the shape of floor-space, technical salaries, electricity consumption and so on, but including set-construction, costume-hire and artists’ fees, we can stage two performances of a given play, revue or variety show, running one hour or more, and having its quota of star names, for as many *hundreds* of pounds as it would take *tens of thousands* of pounds to film—with present-day methods and at present-day costs.

This financial argument may not prevail in the future in the United States, as the cost of lines for a coast-to-coast television hook-up may well be so heavy that the combined cost of filming a programme and transporting a print from television-station to television-station may prove to be less expensive. As a compromise applicable to *this* country, I do, however, see a future in playing a first performance “live” at a peak evening viewing time and recording this and reproducing the record for subsequent day-time repeat performances.

Filming for Re-transmission

I would emphasise that this problem—if indeed it is a problem—is concerned mainly with the theatrical type of television programme; the outside-broadcast of a big sporting event or even of an important occasion must essentially be transmitted “live,” while the outcome is still uncertain, and anything may yet happen. The average studio talks programme would, on the other hand, probably suffer little, if at all, from pre-filming, unless it featured a particularly famous or prominent personality whom viewers would feel they would like to be meeting in the flesh; in that case, “live” television provides the next best thing and, at the same time, keeps the cost down to a reasonable level.

The topical outside broadcast should, if it occurs at an irregular viewing time, and/or if the subject-matter is of exceptional interest, be always concurrently filmed—or otherwise recorded—for subsequent re-transmission during the regular evening programme period. Important outside-broadcast material originating beyond outside-broadcast range should, of course, be filmed direct with a view to transmission when convenient. The B.B.C. Television Service follows now, in so far as is possible, these general precepts in regard to topical events, and with the commissioning next year of our new light-weight outside-broadcast units, and the launching of our proposed film news-review, our practice will follow our theories even more closely than at present.

Lastly, while talking about televised film, it is interesting to remember that by means of electrical phase-reversal we can so transmit negative that it is received in the home as a positive; and as we can, of course, transmit “live” commentary with “canned” picture, it is possible for a filmed news-item to appear on the home television screen within a couple of hours literally of the exposed negative arriving at the laboratories for development. By

such means, as an example, and by using aircraft to fly the unprocessed film from Doncaster to London and later the processed negative from London to New York, our film of the St. Leger last September was televised by the B.B.C. in England in the evening of the day on which the race was run, and by the National Broadcasting Corporation in the United States the following afternoon—and all this without really undue effort.

News Broadcasts

The topical O.B. has no normal equivalent in motion-picture production. It is true that the subject-matter of the average television O.B. is invariably covered by the film news-reels, but they probably allocate little more than a minute of screen time to it, whereas we might well be televising it for more than an hour. Our problem, then, is to sustain interest for a long period and irrespective of whether the event itself proves to be exciting or boring.

I presume to think that we are slowly but surely evolving the right technique for these O.B.s. The producer normally has at his command three cameras, the necessary number of microphones, two commentators, and willing assistants ready to seize celebrities and drag them before the selected camera and microphone for unrehearsed interviews if he decides that this will enliven an otherwise rather dull period.

Camera Positioning

In the early days of television O.B.s, we tended to emulate the newsreel and locate our cameras in different parts of, say, a football ground; we quickly found, however, that it caused considerable mental fatigue to the viewer if, over a long period, he had to keep re-orientating himself as we cut backwards and forwards from camera to camera; and so we developed the so-called "stacked camera" technique whereby the cameras are either bunched close together or else separated but placed in the same *vertical* plane. This is very restful to the viewer and gives him the effect of looking at the event with his unaided eyesight when we use the wide-angle long-shot camera, through a pair of low-power opera-glasses when we cut to a narrow-angle mid-shot camera, and through high-power field-glasses when we switch to a telephoto-lens close-up camera. The relative position in the horizontal plane of this stack of cameras to the centre of the subject being televised is of little consequence; in a theatre-relay, for example, it can be in the centre of the circle or in the boxes, but when considerable and fast movement is expected—as at an ice-hockey match—it is important to choose a position which will entail the minimum of panning, as this gets very tiring to the viewer after the first few minutes.

As an example of the effect of this camera-stacking, I would like to show you an excerpt from "The Barber of Seville," shot on film at the Cambridge Theatre from the exact positions which are occupied by our television cameras when we televise from there; the three selected film camera lenses are, incidentally, substantially of the same angle as those used by the television cameras in the same circumstances.

A filmed excerpt from "The Barber of Seville" was then projected.

Talks and Features

Television talks programmes have even less in common than the topical O.B. with the motion-picture as produced for the kinema, although some have a certain resemblance to the short training films made during the war for the armed forces. They are rarely more than 30 minutes in length, and often make much use of models, animated charts, still pictures and moving pictures. The ratio of screen time devoted to the speaker and to the illustrations is very



Two frames of Film recorded from the Television Transmission of "I Want to be a Doctor."

variable and depends on the topic, on the screen personality of the speaker and on the need—if any—for the speaker actually to handle the subject on which he or she is talking. In a talk on cooking or gardening, the speaker will obviously be in picture a great deal, even though the camera is tracked in very frequently to emphasise, by means of close-up, the subject of the description; in a fashion programme, on the other hand, the cameras would play on the models for the whole duration of the programme, and the compère would be established in vision only at the beginning and end.

By "feature" is meant not necessarily the main item in a given session, as with a feature film, but the type of programme which became known as the "feature programme" in sound-broadcasting—one that is strictly non-theatrical and that deals principally with fact as opposed to fiction; its nearest film equivalent is the documentary. Examples of television features broadcast during this year are the "I want to be . . ." series—"I want to be a doctor," "I want to be a chorus girl," and so on—the student's training providing the main theme; then there was the feature which dealt with the Control of Germany, another which was virtually the illustrated biography of the Chindit leader General Wingate, and there was the programme employing, of course, one of the outside broadcast units, which set out to show viewers the working of a Thames-side sugar refinery. These features run anything up to an hour or so, and often rely to a large extent on the pre-filming of certain sequences.

An excerpt from "I Want to be a Doctor" was projected, which had been recorded on film from the television screen image.

Drama Production

Drama, to the B.B.C., signifies the play—short or long, light or heavy, historical or fictional, classical or modern. And there is no doubt at all that, with the possible exception of the topical outside broadcast, the play is the most popular programme transmitted by the B.B.C. Television Service. Hence I must devote a little time to it.

It has been so far assumed that the general principles of television production as carried out at Alexandra Palace are familiar: how the picture from a given camera is faded in and out, or cut, or dissolved to the picture from another camera, in exactly the same way as is the sound from a microphone; and that the "vision-mixer," as he or she is called, is as integral a part of a television production unit as is the "sound-mixer" of a film production unit; that all camera-operators, dolly-pushers, boom operators, and so on wear head-phones connected to the producer's closed-circuit microphone, and that the producer himself (he would, of course, be termed the director in a film studio) seated in the control gallery between his sound and vision mixers can watch both the picture being transmitted and, on a second screen, the picture offered by any selected one of his other cameras; he can also look straight on to the studio floor through a double-glass window.

It is less realised, however, that with the type of television camera now in use, an appreciable number of engineers is also involved in the control room



Frames from the Film Record of "The Brontës."

doing, in fact, to the electrical picture what the laboratories do to the filmed picture—compensating for variations in lighting and trying to maintain a given uniform gamma.

Lighting Problems

In television-broadcasting there is no question of lighting for long-shot, shooting the long-shot, relighting for mid-shot, shooting the mid-shot, and so on; television lighting has to be universal. This does not necessarily prohibit the use of dramatic lighting, but sudden changes in lighting key have to be avoided, although the effects they would give can be arrived at by electrical adjustment of the camera circuits; such adjustment, however, is manual and not automatic, and any delay results in very indifferent picture quality, with, probably, severe fogging along the bottom and right-hand frame-line. In other words, trick lighting calls for very close collaboration between the producer, the lighting man, and the control engineers, and it is not necessarily the fault of the lighting man if it fails to come off. The same thing can and does apply to what one might call "straight lighting"; only too often what *appears* to be poor lighting is in fact due to electrical troubles in the camera circuits.

Dramatic lighting is, of course, most called for in the play type of programme as opposed to, say, a variety programme, where it is normally desirable to retain high-key lighting. Equally it is in dramatic programmes that the television producer most feels the need for the kinema's reverse angle—a luxury which it is impracticable for him to achieve, not only because it would be difficult for him to avoid showing his reverse angle camera in his frontal cameras, but also because his lighting problems would be accentuated, and last, but not least, because he cannot usually afford to tie up a camera for spasmodic use only.

The television demonstration film, "Television is Here Again," produced for the B.B.C. by Mr. Marcus Cooper, illustrates the control-room and control-gallery set-up, and gives a fairly clear picture of the number of personnel directly involved in the control of a television broadcast.

An excerpt from Reel 1 of "Television is Here Again" was projected.

Production Limitations

There are virtually no limitations, from the *technical* angle, which govern the selection of a story for a motion picture; but for the television-broadcasting drama-producer of to-day there are several. He is limited, normally, to one small stage in which can be erected one reasonably-sized set—or two, three, or four small ones, plus half-a-dozen backings; he can have the use of four cameras and one film channel, but he cannot yet use back-projection. These factors alone normally limit his story selection to those which it would be possible to produce on the theatre-stage and which, accordingly, call for a minimum of sets and of changes in costume and make-up. He has, however, this advantage over the stage-producer: he can—and often does—pre-film

a brief sequence which needs, say, a definite exterior setting, and he can use library or specially-shot film to establish a scene.

It might be thought that with these restrictions, television play productions would all tend to follow the same pattern—but this is not so. The individualities of the different producers are just as marked as those of film directors—not only in the manner in which they direct their artists, but in their technique in handling their cameras. One producer will use but one camera per set; another will always crowd in two, three or four; a third will invariably play in comparatively static close-up, while a fourth will never keep his cameras still.

Tempo of Production

No producer can, of course, succeed in acquiring a very fast-moving tempo by cutting quickly from shot to shot (that is, in television, from camera to camera) and he can gain speed—if he *must* have it—only from the action and voices of his cast. But happily television seems to call for a much slower tempo than the kinema. Whether it is that even the best television pictures are not quite so crystal-clear as a well-projected, well-photographed film, or whether it is that the television viewer is more relaxed than is the kinema patron I do not know. But quick cutting can often be actually objectionable in a televised film, and a televised play can appear much slower when viewed on a kinema-size screen than it does on a small home receiver.

A brief excerpt from a televised play will assist appreciation of these points. The play, in common with most television programmes of this type, had some two weeks of rehearsal in remote rehearsal-rooms and one studio dress-rehearsal only, with lights, cameras and microphones.

An excerpt from "The Brontës" was projected.

Variety Production

The word *variety* covers, in its broadest television sense, all the light musical programmes staged in the television studios, and thus includes, of course, the music-hall type of show as well as revue, cabaret, dance-bands, and so on. The same limitations which cramp the style of the play producers obviously apply equally to the variety producers where set dimensions and the number of cameras are concerned. The variety producer does, however, often score from the standpoint of rehearsals, as many of the acts which he will be televising are already in being as stage acts, and he need only modify them to meet the requirements of the camera lens.

A problem of cutting is how long it is permissible for the television variety producer to hold, say, a vocalist in a given shot without cutting to another angle or without even tracking in or tracking out. In motion-picture production it would of course be only a comparatively few feet, but in television production for the average 10 inch by 8 inch home screen it can very well be several minutes. I thought at one time that the small depth of focus of the present studio television camera had some bearing on the problem, but always I myself come back to the opinion that screen-size is the decisive factor.

Effect of Screen Size

It is generally accepted that the optimum viewing distance for any moving picture is between four and eight times the screen height; and that if this distance is observed the screen is always relatively the same size to the viewer. But psychologically there is a very considerable difference. The kinema went through a phase of big-head close-ups, but they somehow always appeared slightly ridiculous on account of their enormous size. On the small television

screen, however, a big-head close-up is still far from life-size, and it is for this reason possibly that it is acceptable.

The reverse applies to really long shots ; a long establishing shot in the cinema can be held for longer than it can on the home television screen—probably because on the smaller type of television screen detail is missing.

Equally cogent to this argument is the answer as to why quick cutting is untenable in television : on account of lack of detail it takes longer for the eye to assimilate all that is on the television screen than it does for the eye to account for everything on the cinema screen. The different screen sizes found in the home television receiver are definitely a factor which the television producer should take into account.

Size of Audience

If it were so to happen that programmes designed for the home receiver were to be relayed also to cinemas for re-transmission on screens of the order of 20 feet by 16 feet, many producers would feel that they would have to decide whether they were producing primarily for the home receiver or for the cinema, and legislate in camera-angles and in cutting tempo accordingly.

Lastly, the television producer selecting a story for a television play, or selecting the acts for a television variety show, has to remember that his programme as seen in the home will not be subject to mass audience reaction ; it will be seen simultaneously by tens of thousands of people—but they will be in groups of two to six instead of in hundreds. He has to produce his show with this in mind—to build up intimacy, even to direct his artists to commit one of the seven deadly sins of the film studio and look straight into the camera lens.

An excerpt from a variety programme staged at Radiolympia was projected which illustrated the length of time which a given shot may be held. This was followed by an excerpt from another variety programme in which the producer's inter-com. microphone was mixed in on the sound-track in order to demonstrate on the screen the results of the producer's directions, most of which concerned the pre-view picture which followed.

DISCUSSION

MR. MARCUS COOPER : The lecturer has given us a most interesting paper, but the big thing of the evening is that he has been making history. We have seen on the screen some remarkable examples of recorded television images, which compare very favourably with the early days of cinematography.

MR. T. S. LYNDON-HAYNES : As both Group-Capt. Dorté and Mr. More O'Farrell have been in the film business and in television, do they think that, apart from questions of media, there are any fundamental differences in technique ?

MR. G. MORE O'FARRELL* : The inability to re-take is a tremendous strain on the producer. The only way we get round it is by intensive rehearsals beforehand.

MR. B. HONRI : In view of the length of time some of the performances take, how do you deal with matters of ventilation and heat ? What lighting intensities do you work at ? Do you use compact light sources ?

THE AUTHOR : At the moment we are using incandescent lighting, but experiments are going on with compact source lights. Ventilation is as it is in any film stage. The general illumination is just about the same as that used for a monochrome motion picture.

MR. H. WAXMAN : I have visited Alexandra Palace during a transmission, and I should say that the level of illumination was of the order of 300 to 400 foot-candles. What is the general level ?

THE AUTHOR : The equipment we are using at Alexandra Palace was designed in 1935 and made in 1936/7 ; and our very obsolete cameras are unquestionably temperamental. They vary not only from day to day in sensitivity, but hourly. The average illumination used in the studios varies enormously.

The Super-Emitron Camera is much more sensitive, and is therefore allocated entirely to O.B.s, because in O.B.s we have to be prepared for conditions of low illumination.

*Senior Television Producer, B.B.C.

Mr. T. M. C. LANCE : I would like to support Group-Capt. Dorté on the description of the new camera. I have seen it in use in New York, and the sensitivity was sufficient to use a Zoomar lens with 15 to 20 foot-candles. The turret supplied has normal kinema lenses, 35 mm., 50 mm., and 150 mm., and they work down to $f/8$ at 50 foot-candles.

Mr. LASSALLY : To what type of film stock could you liken the television camera ? Is it blue-sensitive, or is it panchromatic ?

THE AUTHOR : It is substantially panchromatic. I would liken it to Plus-X.

Mr. L. H. BACON : I have seen it alleged that you can get a 100 : 1 contrast from a projected positive, whereas the television equivalent is of the order of 10 : 1.

THE AUTHOR : With regard to the light contrast in recordings, it was really unfair to television that I projected them here tonight. The exposure and gamma were intended for experimental closed-circuit reproduction on television ; they were not designed for big-screen projection.

Mr. R. H. CRICKS : This question of gamma we overcome in the film trade by means of step wedges. Would it not be

possible to transmit a step wedge before a programme, and check the transmitter by means of a similar wedge ?

THE AUTHOR : I maintain it is impossible for a step wedge to be effective for all the conditions under which a television camera may be used. We transmit a carefully designed tuning signal before each programme and the viewer should be able correctly to adjust his receiver linearity and contrast on this signal.

EDITOR'S NOTE.

The frames reproduced on pages 167 and 168 of frames recorded from television images were produced by an experimental apparatus, in which one interlacing only of the frame was reproduced, resulting in an equivalent definition of only 200 lines.

The B.B.C. engineers have since developed an improved apparatus, in which both interlaced scans are reproduced. It can also be readily adapted for more than two scans per picture, as may be required for colour pictures. A Mechau non-intermittent projector is used, modified to act as a camera ; the speed of operation is adjusted to be approximately correct, and locking to the television picture frequency is not necessary.

BOOK REVIEW

SOUND AND THE DOCUMENTARY FILM by K. Cameron (157 pages, Sir Isaac Pitman & Sons, Ltd., 15s.).

Sound technicians are usually very reticent concerning their craft, and this contribution to the existing publications on the subject will appeal not only to the new recruits to whom it is dedicated, but also to all those work brings them into contact with soundmen.

It describes the various stages in film production from the sound point of view in a brisk, clear style, which is happily free from unnecessary technical terms and jargon. The technique described seems, however, more in line with feature film production, and the author has failed to draw any clear distinction. For instance, the use of light portable recorders and single-system cameras is barely mentioned.

Music arrangement and recording is dealt with in some detail, with particular reference to the use of large orchestras, and the author's experiences and views on the subject are of real value to musicians

and technicians alike. The limiting factors imposed by 16 mm. distribution are also well expressed and are one of the most important aspects of the subject.

Throughout the book, Mr. Cameron shows a deep admiration for American apparatus and technique, to the extent, that not one of the several British makes of apparatus so widely used on documentary films is even mentioned ! On the other hand, American apparatus is well illustrated and described in technical abstracts, which cover many details in condensed and, in general, accurate form, although it will be news to many to learn on page 109 that RCA use a moving coil galvanometer.

A comprehensive Glossary of Technical Terms is included, and here again, the Hollywood flavour, so foreign to documentary work, is strong. We are helpfully told that S.M.P.E. means Society of Motion Picture Engineers, while the British Kinematograph Society is apparently not worthy of mention.

NORMAN LEEVERS.

ILLUMINATING ENGINEERING SOCIETY

A Summer Meeting is to be held in Harrogate between June 16th and 19th. One of the lectures will be given by Mr.

L. C. Jesty, B.Sc., M.I.E.E., F.B.K.S., on the subject of television.

TECHNICAL ABSTRACTS

Most of the periodicals here abstracted may be seen in the Society's Library

THE PROCESSING OF TWO-COLOUR PRINTS BY DEEP-TANK METHODS.

John G. Stott, *J. Soc. Mot. Pic. Eng.*, Oct., 1947, p. 306.

The author describes a protective lacquer (Eastman Universal Protective Film Lacquer), which can be applied to one side of a duplex print to prevent the access of the solutions used to tone the other side. The lacquer is easily removed in an alkaline bath. M. V. H.

BLACK-AND-WHITE DUPLICATING TECHNIQUES USED IN HOLLYWOOD.

Norwood L. Simmons and Emery Huse, *J. Soc. Mot. Pic. Eng.*, Oct., 1947, p. 316.

The authors have carried out a valuable and instructive investigation of the duping techniques used by five Hollywood laboratories, both sensitometrically and by asking them all to duplicate identical lengths of negative. Whereas the prints from the duplicates were in all cases satisfactory, a marked tendency to underexpose both master and dupe was noted. M. V. H.

DETERMINING COLOUR BALANCE OF 16 MM. KODACHROME PRINTERS.

Paul S. Aex, *J. Soc. Mot. Pic. Eng.*, Nov., 1947.

After a brief summary of the usual method of balancing printers for colour-balance and exposure by means of test prints, the author describes an instrument, consisting of a barrier photo-cell and galvanometer, which can be inserted into the printer aperture. Standard tricolour filters can be put in front of the cell, and these tricolour readings enable other printers to be balanced to one master printer, enable routine day-to-day checks on balance and exposure to be made, and facilitate changing from one emulsion to another. M. V. H.

DESIGN FACTORS IN 35 MM. INTERMITTENT MECHANISMS.

A. Hayek, *J. Soc. Mot. Pic. Eng.*, Nov., 1947, p. 405.

An analysis of the action of the Maltese cross device shows that the maximum acceleration imparted to the film is 5,000 f.p.s.². Theoretical considerations indicate that if a mechanism could be devised to impart an equal but constant acceleration to the film, and if furthermore, the gate tension were lifted during the acceleration period of the picture cycle, it should be possible to procure a pull-down angle of 37°, which would nevertheless impose no more stress upon the film than with the orthodox mechanism. R. H. C.

DYNAMIC NOISE SUPPRESSOR.

H. H. Scott, *Electronics*, Dec., 1947, p. 96.

Background noises in sound recordings are usually rich in both high frequency and extreme low frequency components, and restriction of the high and low frequency response of a reproducing amplifier will improve signal-to-noise ratio.

Amplifiers are described in which the limits of the effective frequency range handled are set by low-pass and high-pass filters, the cut-off frequencies of the filters being controlled by the amplitude of the incoming signal. At low amplitudes a restricted frequency band is amplified, while at high volume levels the full audio range is reproduced.

Detailed circuit diagrams and useful operating notes are given.

N. L.

AUDIO NOISE REDUCTION CIRCUITS.

H. F. Olsen, *Electronics*, Dec., 1947, p. 118.

Two germanium diodes may be connected in shunt-opposition to form a non-linear element, which presents a high resistance to small applied voltages, and a low resistance to voltages above a critical value. Such an element will discriminate between signal and background noise in a sound reproducer, and spurious harmonics introduced by the non-linear element may be minimised by limiting the frequency band passed through such an element to about one octave.

Amplifiers are described in which the high frequencies are passed through one and three such channels respectively.

N. L.

LIGHTWEIGHT RECORDERS FOR 35 AND 16 MM. FILM.

M. E. Collins, *J. Soc. Mot. Pic. Eng.*, Nov., 1947, p. 415.

New RCA recording machines are described in which a simplified film drive is employed enabling the film to run in either direction. The scanning drum shaft carries a conventional solid flywheel, which is driven by the film. Compliance is introduced by a pair of spring loaded jockey rollers, one of which carries an air dashpot. Flutter content is particularly low for a lightweight recorder.

Other practical features include a gear driven reversible take-up mechanism and interchangeable driving motors. N. L.

LEAD-SULFIDE PHOTOCONDUCTIVE CELLS FOR SOUND REPRODUCTION.

R. J. Cashman, *J. Soc. Mot. Pic. Eng.*, Oct., 1947, p. 342.

War-time development in the U.S.A. produced the lead sulphide light-sensitive cell in a form which may be used in place of conventional photo-emissive cells for sound reproduction. Important features of the cell are high sensitivity, particularly in the infra-red region, low noise level, low impedance, excellent frequency response, and absence of microphonic noise. The high sensitivity to infra-red radiation makes possible the use of indirectly heated exciter lamps on raw A.C. N. L.

SYNCHRONISED 16 MM. SOUND AND PICTURE FOR PROJECTION AT 16 FRAMES PER SECOND.

George E. H. Hanson, *J. Soc. Mot. Pic. Eng.*, Oct., 1947, p. 357.

A re-recording set-up is described, in which the original track is made on 35 mm. film at 90 feet per minute. This master is then re-recorded to 16 mm. film at the standard speed of 36 feet per minute, the play-off head running at $1\frac{1}{2}$ times normal speed. The resulting track is suitable for reproduction at 16 p.p.s. speed, and comparative response curves are given. N. L.

OPTIMUM WIDTH OF ILLUMINATION OF SOUND TRACK IN SOUND-REPRODUCING OPTICS.

Joseph C. Frommer, *J. Soc. Mot. Pic. Eng.*, Oct., 1947, p. 361.

The scanning width for maximum response is expressed in terms of frequency and film speed, and regardless of actual frequency response, which may be equalised. This expression is then modified to give the optimum maximum signal-to-noise ratio, taking into account the increase of cell-noise with illumination. N. L.

TWO-CHANNEL STEREOPHONY WITH THE MAGNETOPHONE.

Dr. W. Lippert, *Funk und Ton*, Oct., 1947.

This article concerning stereophonic recording on the Magnetophone, describes the basic principles of stereophony by citing all the well-known authors on this subject such as K. de Boer, H. Warncke and Fletcher, and gives abstracts of their work, without yet, however, describing the results obtained with the Magnetophone. O. K. K.

PORTABLE AND SEMI-PORTABLE LOUDSPEAKER SYSTEMS FOR REPRODUCING 16 MM. SOUND-ON-FILM.

John K. Hilliard, *J. Soc. Mot. Pic. Eng.*, Nov., 1947, p. 431.

The "dia-cone" loud speaker units described have a three-inch diameter voice coil which drives the usual paper diaphragm serving the lower and middle audio range. The centre of the cone carries a convex spherical metal diaphragm, which is effective at high frequencies.

In one model a small multi-cellular horn is mounted within the cone, with its throat close to the metal diaphragm, to give improved directional properties. N. L.

SCIENCE APPLIED TO THE SCREEN.

R. H. Cricks, *Ideal Kinema*, Oct., 1947, p. 17.

Polar curves demonstrate the very wide difference in reflectivity characteristics between various types of screen surfaces. It is considered that a substantial improvement in picture brightness could be attained if a range of surfaces were available, suited to different types of auditoria, which would be chosen by reference to polar curves.

AUTHOR'S ABSTRACT.

THE COUNCIL

Meeting of 7th April, 1948

Present : Messrs. I. D. Wratten (*President*), W. M. Harcourt (*Vice-President*), P. H. Bastie (*Hon. Treasurer*), R. B. Hartley, B. Honri, L. Knopp, A. W. Watkins, R. Pulman (*representing Theatre Division*), H. S. Hind (*representing Sub-Standard Film Division*), G. Burgess (*representing Film Production Division*) and R. H. Cricks (*Secretary*). In attendance Mr. J. Foster (*Auditor*).

Training and Apprenticeship Council.—The Secretary submitted a report of a meeting attended by himself and Mr. L. J. Hibbert, of the Education Committee of the Film Industry Training and Apprenticeship Council.

Annual Accounts.—Mr. Foster submitted the audited accounts for 1947. He drew attention to the reserve for income tax of £190 16s. 0d., on which he was hopeful of obtaining a rebate. He pointed out, however, that losses incurred prior to the incorporation of the Society could not be carried forward for tax purposes.

Annual Elections.—Messrs. A. H. C. Rouse and W. Bland were appointed scrutineers in the election for officers and members of Council.

Secretaryship.—It was reported that an applicant for the position of Secretary had found himself unable to accept the post. The Executive Committee was empowered to engage a suitable person.

Provincial Sections.—Following a report by Mr. Pulman on the position of the provincial sections of the Theatre Division, it was decided to form a Branches Committee to supervise Branches and Sections, comprising the Vice-President (Chairman), the remaining three officers, Messrs. Champion and Pulman, a representative from each Division, and a representative from each Branch as it was formed.

Co-operation with S.M.P.E.—Material for the monthly letter to the S.M.P.E. was considered.

Film Mutilation Brochures.—It was reported that the Joint Committee was making satisfactory progress with the preparation of brochures on film mutilation.

Home Office Regulations.—Progress was reported on the proposed revisions to the draft Cinematograph Act regulations.

Fellowship.—It was agreed to extend the date for the return of Fellowship nomination forms to 1st June.

National Joint Film Production Council.—A letter from the Board of Trade was submitted, stating that it was not possible to include a representative of the Society on the Council.

Papers Committee.—The policy of the Papers Committee, of ensuring a high scientific standard for Society meetings, was endorsed.

Theatre Division.—It was agreed that when an applicant for Corporate Membership indicated his desire to join the Theatre Division, his proposal form should be considered by the Committee of the Division.

Training of Projectionists.—At the request of the Theatre Division Committee, it was agreed to address an enquiry to the C.E.A. and the N.A.T.K.E. concerning the proposal training and apprenticeship scheme for projectionists.

Film Production Division.—It was reported that arrangements were well in hand for the visit by members to the M.G.M. Studios, Elstree, on May 8th.

British Standards Institution.—Each Division was requested to nominate a representative to B.S.I. Committee CME/-.

Membership Certificates.—In regard to a problem which had arisen regarding the date to be inserted on membership certificates, it was agreed that in the case of those Members and Associates who were enrolled in the unincorporated Society, the date shown should be that of the incorporation; in the case of Fellows and all Members and Associates elected since the date of incorporation, the date should be that of election. If however, any person wished the date of his original election (when prior to incorporation) to be shown upon the certificate, it could be inserted at a charge of 5s.

Retiring President.—Expressions of good-will were conveyed to Mr. I. D. Wratten.

EXECUTIVE COMMITTEE

Meeting of 7th April, 1948

Present : Messrs. I. D. Wratten (*President*), W. M. Harcourt (*Vice-President*), P. H. Bastie (*Hon. Treasurer*), R. H. Cricks (*Secretary*), Miss S. M. Barlow (*Assistant Secretary*).

Elections.—The following were elected :—

DOUGLAS HAROLD ELLIS (Associate), National Screen Advertising, Baghdad.
 ALAN A. WILLIAMS (Associate), Olympia Cinema, Tredegar.
 HYMAN GOLDIN (Associate), Gaumont-Kalee, Ltd., Toronto.
 Miss RUTH PRATT (Associate), British Instructional Films, Ltd.
 ROBERT GORDON SMITH (Associate), Empire Cinema, Bedford.
 JOHN ERIC SHEPARD WHITE (Student), Polytechnic, Regent Street.
 JAMES MILLER (Member), Regal Cinema, Glasgow.
 CLIFFORD LESLIE DEAKIN (Member), Cheshire County Cinemas, Ltd.
 DOUGLAS DALLEY BROADFOOT (Associate), The Crowthorn Engineering Co., Ltd., Redditch
 IVOR ROTHNELL WORSLEY (Associate), British Lion Studio Co., Ltd.
 ARTHUR RICHARD POWELL (Member), Western Electric, Ltd.
 ERNEST DENNIS RUNKEL (Member), E. D. Runkel & Son.
 ESAT OZGUL (Student), Colonial Film Unit.
 PETER BEVERLEY BROWN (Student), Wireless College.
 EDWARD DOUGLAS TAYLOR (Associate), Science Films, Ltd.
 CHARLES ELLIOTT ANDREWS (Member), Warner Theatre, Leicester Sq., W.C.2.
 HAROLD LAWRENCE SMITH (Member), Proprietor "Weekly Cinemas."
 GERALD ISAAC PASTERNAK LEVENSON, Kodak Research Laboratories.
 HARRY JAMES ROGERS (Member), G. B. Equipments, Ltd.
 ARTHUR FREDERICK LAVIS (Associate), Chelsea Colour Films, Ltd.
 WALTER FRED DORMER (Member), W. F. Dormer, Ltd.

Transfers.—The following Associates were transferred to Corporate Membership :—

THOMAS HUGILL WATERWORTH, M.G.M. Studios.
 OWEN FRANKLIN ALBRIGHT GOLLINGS, Film Production Supervisor, Admiralty.
 EDWARD HAROLD VIVEASH, Crown Film Unit.
 SIDNEY ARTHUR COOK, Pullin Optical Co.
 ALEXANDER AMBROSE WATERS, United Motion Pictures Ltd.

Resignations.—The following resignations were accepted with regret :—

ANTHONY BATEMAN (Associate). LEONARD LIPTON (Student).
 HAROLD FRASER (Member). FREDERICK JENNER TRITTON (Member).

ORDINARY MEETING

The second Ordinary Meeting of the British Kinematograph Society was held on 28th April, 1948, at Film House, Wardour Street, W.1. The President, Mr. I. D. Wratten, was in the chair.

Minutes

The Minutes of the Ordinary Meeting of 14th May, 1947, were, in the absence of Mr. E. Oram, the Hon. Secretary, read by Mr. W. M. Harcourt, Vice-President, and were agreed.

Hon. Secretary's Report

The report of the Hon. Secretary was also read by Mr. Harcourt, as follows :—

Whilst making this my annual report, I realise the similarity of the Society's problems to those of most business concerns today, although this Society does not concern itself with such mundane matters as trading.

We, like most businesses, are extremely busy expanding, and inclined to incur an increasing expenditure out of proportion to the assured income.

Membership.—Once again I am able to report an increase in our membership. A great deal of this is due to the efforts of Mr. Rex Hartley and Mr. Cricks, and although the increase is substantial, I am sure we would all like to see a still further increase, as it is necessary to relate our considerably increased activities to a total membership. As will be seen by the later reference, our activities in the form of meetings are reaching enormous proportions. The figures of membership are as follows :—

	1947	1948
HON. FELLOWS, FELLOWS and HON. MEMBERS ...	—	20
CORPORATE MEMBERS	448	528
ASSOCIATES	386	389
STUDENTS	67	86
	<hr/> 901	<hr/> 1023

These figures show a net increase of 122.

Fellowship.—The fifteen Fellows originally elected in November, 1946, have prepared regulations for the subsequent conferment of the Fellowship and Hon. Fellowship, which

were confirmed by the Council. Under these regulations, the Council has been pleased to honour two of our founder members, Messrs. P. H. Bastie and A. G. D. West, by the Hon. Fellowship, and has conferred the Fellowship upon Mr. Rex B. Hartley. Nominations for further Fellowships are now being received.

Meetings.—The total number of meetings, that is, Committee Meetings, Sectional Meetings, and all meetings other than General Meetings of the Society, and Joint Meetings with the Royal Photographic Society and the Association of Cine-Technicians, etc., have this year totalled over 120, compared with a pre-war record of 15 to 20 meetings.

Education.—The Polytechnic full-time Course with which you are all familiar has been continued, and this two-year Course has been filled to capacity with ex-service students, and in fact, applications have had to be turned down. Educational activities are and should be one of our first considerations, including as they do, lectures and the dissemination of technical knowledge.

A contribution during this year, which has necessitated time and energy being given by members—led by your President—is the brochures on “Film Mutilation” which will shortly appear; this is an indication of the scope of the valuable help the Society can give to the industry.

General Meetings.—The programmes circulated give an indication of the wide range of subjects covered in our lecture programmes, which, of course, are one of the main features of the Society, contributing to the educational aspects and objects for which the Society was primarily formed. The meetings have, as in past years, covered the Newcastle-on-Tyne and Manchester Sections, and have included joint meetings with the Royal Photographic Society and Association of Cine-Technicians. The attendance figures have been exceptionally good.

Every year I make a plea for suggestions from members to guide the various Papers Committees, and I do not hesitate to again putting forward this appeal.

Divisions.—The Divisions and their activities continue to grow. The Sub-Standard Division has increased from 162 to 204, the Theatre Division from 340 to 387, the Film Production Division from 347 to 373.

Standardisation.—The past year has shown an increase in the activities of the British Standards Institution Committees, and although there is not a large number of new standards published, much work has been done in reviewing existing American standards and surveying the whole field. A number of standards, including such items as Projection Lens Fittings and Release Print Reels, are nearing completion.

The Cinematograph Industry Committee and the various Technical Committees have a large programme before them, and the Society is very strongly represented, and is in fact, taking a leading part in this work.

Library.—I think there are not many who appreciate the vast amount of work put into the organising and maintenance of our Library, which is open every day, and each Monday evening until 8 p.m. I can assure you that Mr. Rex Hartley and his willing helpers have given a great deal of time to this work. You have heard Mr. Hartley's appeal for support in this direction, and I think if more members would make use of the Library facilities, they would more readily appreciate the work that has been put into this, and the need for every member's support in the way of contributions of technical books, journals, etc.

British Kinematography.—Since July last, the Journal, under the new title of *British Kinematography*, has been published monthly instead of quarterly, and only those on the inside of the organisation can appreciate what this means in the way of increased work. Although there may be useful criticisms which can be put forward and which I am sure will be welcomed by the Journal Committee, I think everyone will agree that the very high standard has been maintained. Having regard to the value of this in our educational programme and as a means of increasing our membership, I am sure you will readily agree that our heartiest thanks should be recorded to Mr. Cricks and to the Journal Committee.

Patron Members.—Not only do I wish once again to record our appreciation of our Patron Members' generous support, but I wish to express how gratifying it is to have received the support of a number of new Patron Members. The figures are shown in our accounts which have been circulated to all members.

Finance.—A review of the finance of the Society will be left to our Hon. Treasurer but I would like to stress that although this Society is not established as a profit-making concern, it finds its expenditure increasing very rapidly with the increase in membership and with the exceptional increase in activities which it has undertaken. Each of the Committee Meetings and General Meetings incurs expenditure; as our President will no doubt advise you, it is necessary to appreciate that our membership is the back-bone of the Society and that there is a danger of the increased activities and our expenditure growing

out of proportion to the increase in membership. It is on this point that members can help by taking active steps to introduce new members of the right type, and I am sure in this direction they have a good example in Mr. Rex Hartley, who has contributed so much in the last few years to our increasing membership.

In conclusion, I would like to stress how fortunate we have been in our choice of President over the last two years : few realise the vast amount of time and energy he has given to the Society's work. I am sorry that owing to absence abroad I shall not be present to express on behalf of all members as well as myself, our appreciation of his untiring efforts, but I know that we can look forward to his continued help and support to our new President.

With regard to Mr. Cricks, the considerable increase in work in the organisation of the Society has placed a very heavy load on him, and in view of this, the Executive Committee has considered obtaining for him some relief. I know that you will all appreciate the work he has done and is continuing to do, but I do make the appeal to all members to give any assistance they can in the routine work, especially those members of Committees who may not always realise that each meeting involves a considerable amount of office work and general guidance, for which we are inadequately staffed, whilst we are extending so rapidly.

Hon. Treasurer's Report

The Hon. Treasurer, Mr. P. H. Bastie, in submitting the accounts for the year, drew attention to the deficit of £378 14s. 10d. ; fortunately, however, in the war-time years, it had been possible to build up a reserve, and although it had not so far been necessary to draw upon it, it might prove necessary during the current year.

The cause of the deficit was, he continued, the continually increasing costs of all requirements. Further, although the Society was not a trading concern, it had been compelled to pay the sum of £193 10s. 0d. in income tax, although it was hoped to recover part of this payment. Increased expenditure had also been incurred by the Divisions and Provincial Sections, and by the monthly publication of *British Kinematography*.

On the proposal of Mr. R. Pulman, seconded by Mr. K. Baron Hartley, the reports and accounts were adopted.

Annual Election

The President reported that the following had been elected unopposed :—

President	Mr. W. M. HARCOURT
Hon. Secretary	Mr. E. ORAM
Hon. Treasurer	Mr. P. H. BASTIE

The President announced that Messrs. W. Bland and A. H. C. Rouse had been appointed scrutineers. Mr. Bland reported that the following had been elected :—

Vice-President	Mr. A. W. WATKINS
Members of Council	Messrs. A. G. D. WEST LESLIE KNOPP* REX B. HARTLEY F. G. GUNN

The President declared the above duly elected, and moved a vote of thanks to the scrutineers.

Appointment of Auditor

On the proposal of Mr. Rex B. Hartley, seconded by Mr. A. W. Watkins, Mr. J. Foster, Incorporated Accountant, was appointed Auditor.

Address by retiring President

Mr. Wratten, welcoming the newly elected President, paid tribute to his many excellent qualities. He expressed pleasure at the re-election of Messrs. Oram and Bastie, and at the election as Vice-President of Mr. A. W. Watkins.

The Council had, he said, given much time and unselfish effort to the affairs of the Society. He described the Secretary, Mr. R. H. Cricks, as one of the main pillars of the Society.

It is, continued Mr. Wratten, always advisable for a new President to take over with the fewest problems confronting him. Chief of these problems was finance, and in this connection the Council had decided that the precedent of other societies should be followed, in that a small charge should be made for refreshments at meetings.

The Council had worked to cement good relations with another society, whose objects were almost identical, the Society of Motion Picture Engineers. As a result of Mr. A. G. D. West's attendance at the Autumn Convention, a close measure of co-operation had been effected. Mr. Wratten read a letter he had just received from Mr. Loren L. Ryder,

*Including votes gained in Vice-Presidential election.

S.M.P.E. President, confirming the friendly relationship now established, and expressing appreciation of the work of the B.K.S.

Votes of Thanks

Mr. Wratten concluded by moving a vote of thanks to the G. B. Picture Corporation for the use of the theatre, and to Mr. J. S. Abbott and his staff; to the Patron Members; to the advertisers in *British Kinematography*; to the trade press for their generous reports of meetings; and to all members of Committees.

Mr. T. S. Lyndon-Haynes proposed a vote of thanks to the Officers and Council for their work during the past year. Those present knew better than the majority of the membership the tremendous amount of work put upon them. The period of Mr. Wratten's Presidency had been a transitional period, during which the incorporated Society had taken over from the original body; in this connection, he was glad to see Mr. A. G. D. West was still on the Council.

Dr. F. S. Hawkins, seconding the motion, suggested that one could judge of the excellence of the unseen work of the Council, by the high standard of their seen work. The motion was carried amid loud applause.

Mr. W. J. Raymont, as a new Member, asked that Members of Council should make themselves known to the membership.

The meeting concluded with expressions of deep appreciation to Mr. Wratten from Messrs. W. M. Harcourt, A. W. Watkins, and A. G. D. West, the last referring to his earlier services as Vice-President.

DIVISIONAL COMMITTEES

The composition of the Divisional Committees for the current year, as completed by the recent elections, is as follows:

		<i>Appointed by Council until 1949</i>	<i>Appointed by Council until 1950</i>	<i>Elected until 1949</i>	<i>Elected until 1950</i>
THEATRE DIVISION	S. B. Swingler <i>Chairman</i> R. Pulman <i>Council Representative</i>	W. F. Garling S. T. Perry J. L. Stableford	C. H. Champion R. Pulman H. C. Stringer	S. A. Stevens F. H. Sheridan- Shaw J. A. Walters	C. H. Bell W. V. De Wan L. Knopp
SUB-STANDARD DIVISION	H. S. Hind <i>Chairman</i> <i>and Council Representative</i>	W. Buckstone S. Schofield	C. Cabirol N. Leevors	H. E. Dance *G. H. Sewell *Deputy F. V. T. Heath	D. Cantlay D. Ward
FILM PRODUCTION DIVISION	A. W. Watkins <i>Chairman</i> H. Waxman <i>Council Representative</i>	F. G. Gunn H. Harris T. Howard	C. E. W. Crowhurst W. M. Harcourt R. B. Hartley	F. J. G. Cox C. R. Johnson (<i>co-opted</i>) H. Waxman F. A. Young	G. E. Burgess B. Honri B. C. Sewell

Reports of the annual meetings of the Divisions are unavoidably held over until next month.

PERSONAL NEWS of MEMBERS

Members are urged to keep their fellow members conversant with their activities through the medium of British Kinematography.

H. K. BOURNE, now with Mole-Richardson, has returned from a visit to the U.S.A.

J. P. J. CHAPMAN has left for a visit to Switzerland and Venice.

RAYMOND ELTON has left Guild House and is now Lighting Cameraman at the Shepherds Bush Studios.

LOUIS MANNIX, formerly President of the Cinema Managers' Association, on its amalgamation with the Society of Cinema Managers refused nomination to the Vice-Presidency.

C. V. MONKMAN has been elected a Fellow of the Royal Society of Arts.

HERBERT PAUL has joined Speed Lamps,

Ltd., as technical director for the development of electronic discharge lamps for photographic purposes.

JAN SIKORSKI

Died 5th May, 1948

Mr. Sikorski entered the film industry in 1931 as a camera operator in the Warsaw Film Studio. He served with the Polish Air Force and the R.A.F. before and during the war, and was discharged as medically unfit in 1942. He was employed as a cameraman by the Polish Ministry of Information from 1942 to 1943, when he joined P. & C. Film Productions, Ltd., in a similar position.



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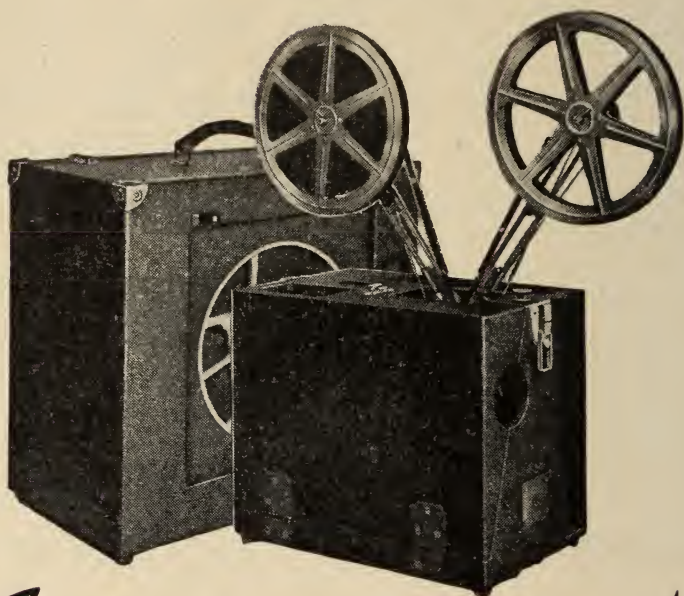
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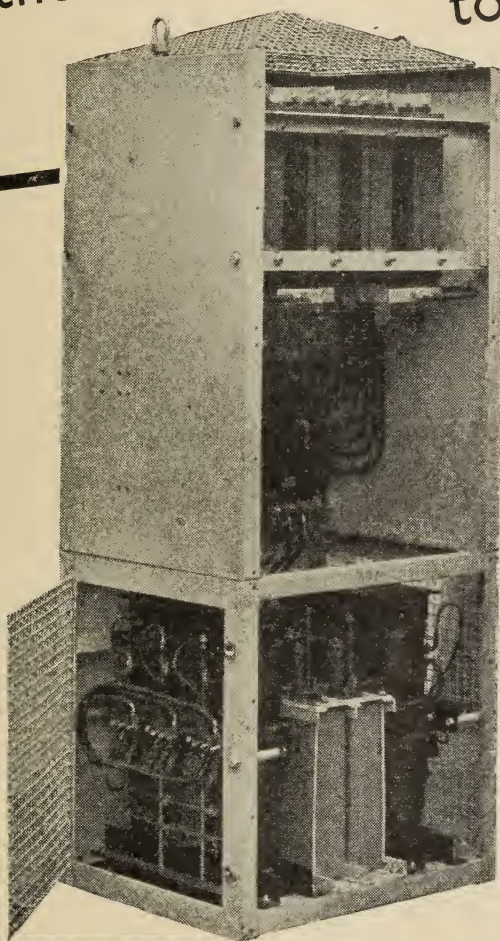
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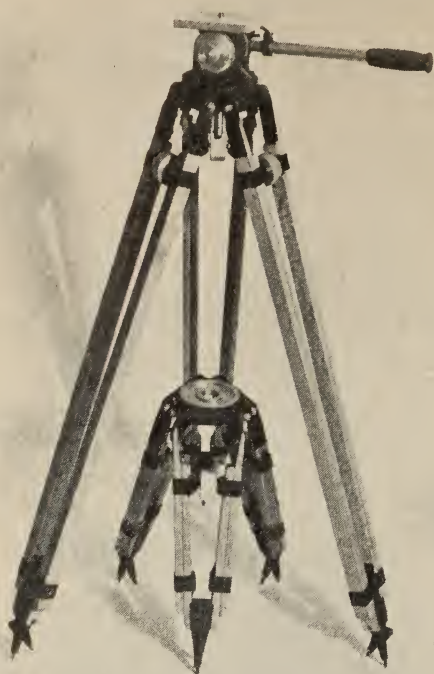


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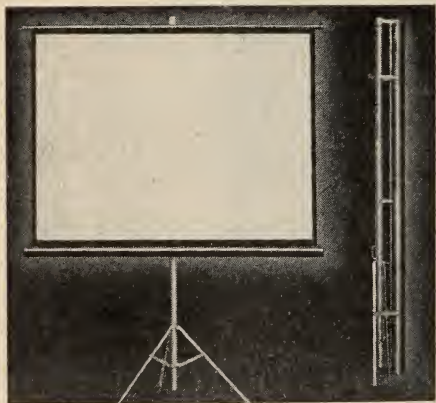
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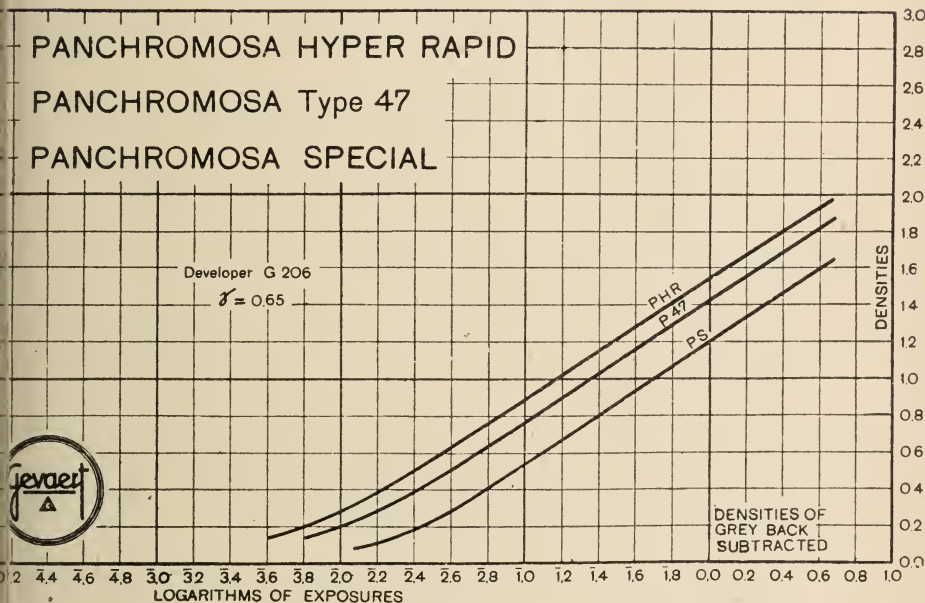
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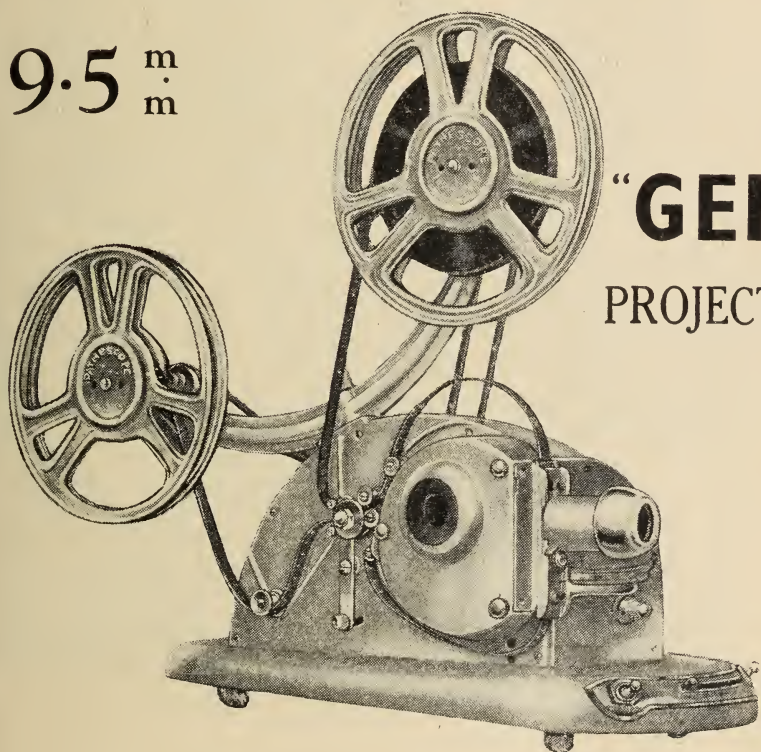
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BRITISH KINEMATOGRAPHY

The Journal of the British Kinematograph Society

VOLUME TWELVE, No. 6.

JUNE, 1948

PHASE MODULATION PRINCIPLES APPLIED TO SOUND RECORDING

Symposium presented to the British Kinematograph Society on March 10th, 1948.

I. INTRODUCTION

Norman Leever, B.Sc., A.C.G.I., M.B.K.S.*

THE use of a frequency modulated carrier as a means of translating sound waves into an electrical form suitable for feeding to a sound recording machine opens up interesting possibilities. While we do not intend to deal with the question of recording the carrier wave itself, we will describe experiments and research relating to microphones, modulators and demodulators.

The carrier wave systems of sound transmission have, up to the present, been considered rather outside the scope of sound recording technique, and a few introductory remarks may therefore be permissible.

In sound recording we are accustomed to thinking in terms of amplifying the most useful part of the audible spectrum, a frequency range of some eight octaves. If instead of trying to deal with this wide band of frequencies we start with a very high frequency generated by artificial means, and cause our audio signal to modulate this frequency, from this point onwards our audio signal temporarily loses its identity, and the system need only pass a relatively narrow frequency band on either side of the carrier wave frequency itself.

Frequency Modulation and Phase Modulation

The audio signal may be arranged to vary the amplitude of the carrier wave, giving amplitude modulation, or it may vary the frequency of the carrier wave. In the latter case it may be understood that as the carrier frequency is shifted about its nominal value, its instantaneous voltage may be said to lag or lead in phase relationship with the unmodulated voltage. If the frequency deviation is proportional to the modulating voltage the effect is true "frequency modulation," while if the phase deviation is proportional to modulating voltage the effect is termed "phase modulation." At a later stage in the transmission chain the carrier wave may be demodulated to re-create the wave form of the original signal.

Frequency modulation is by no means unknown in sound recording and reproduction, for all forms of flutter become audible by modulating the signal itself. The recorded sound then serves as the carrier wave, while the speed

*Leever, Rich & Co., Ltd.

discrepancy between recording and reproduction becomes the modulation. If we record a constant frequency to serve as a carrier, we may detect the flutter by means of a discriminator, and measure its characteristics.

Apart from this particular instance, it is usually expedient to operate F.M. systems at very high carrier frequencies, of the order of 50 to 100 megacycles. At these high frequencies, we find that circuit performance is governed in varying degree by transit-time phenomena in the valves we use.

An electronic capacity measuring device making use of this phenomenon comprises a phase modulated oscillator, a peak limiter and a demodulator in one small unit, using a single valve. The device is termed a "Phasitron,"* and when arranged to indicate atmospheric pressure exhibited such sensitivity and stability that it seemed well worth while to investigate its performance in conjunction with a condenser microphone.

II. THE "PHASITRON"

J. A. Sargrove, M.Brit.I.R.E., A.M.I.E.E.†

THE "Phasitron" device was the outcome of research work carried out some years ago to ascertain the cause of parasitic noise in frequency-changing valves, and is an example of turning to good account a phenomenon which was a nuisance in multi-grid structures.

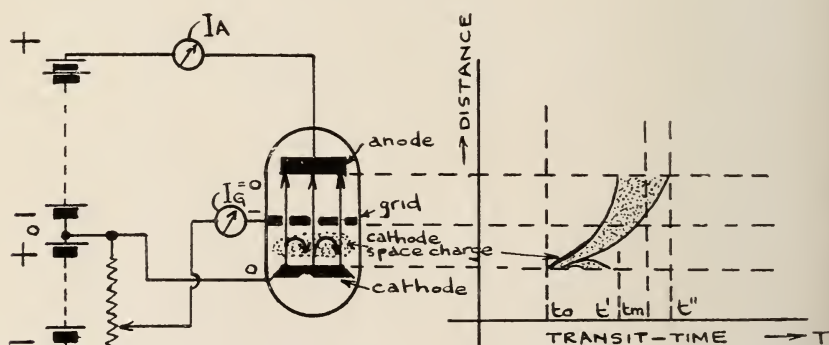


Fig. 1. Space-charge and Transit Time in Triode Valve.

The normal flow of electrons in a triode valve is illustrated in Fig. 1. On the left-hand side is a simple representation of a triode, having a cathode which is emissive either by thermionic or other physical means, a grid, and an anode, each having normal operating potentials. Current meters are inserted into these two electrode leads.

Space Charge

It is known that the electrons leaving the cathode, and having a slight negative charge with reference to the cathode, are decelerated by the cloud of previously emitted electrons and repelled by the larger negative potential of the grid, and thus form the so-called cathode-space-charge which is a cloud of electrons in a state of instantaneous zero velocity in a forward direction, but which may have a sideways velocity without affecting matters at all. This instantaneous condition is due to the fact

*British Patent No. 558036

†Sargrove Electronics, Ltd.

that the electrons have emerged at varying velocities from the cathode surface, have reached this point in space, together with a large number of other electrons all having a negative charge, and hence a decelerating influence on each other, and unless attracted by some other influence will reverse their direction and move back to the cathode. Hence the number of electrons in the cathode space is at equilibrium. The point at which these electrons reverse their direction is at a lesser or greater distance from the cathode according to the different initial velocity (following the law of probability) of the original cathode emission.

Some of the faster moving electrons actually reach so far away from the cathode before entirely losing velocity that they come within the influence of the positive anode field which penetrates through the interstices of the grid, they are re-accelerated in the direction of the anode, fly through the grid, and ultimately reach the anode at varying velocities. In the right-hand side diagram of Fig. 1 is plotted transit-time *versus* distance, the time axis representing an arbitrary time interval of the order of 10^{-7} to 10^{-8} seconds (naturally this depends on the operating conditions, distances, etc., of the actual valve structure). In this diagram it is imagined that the cathode is only emissive for an infinitely small instant and this pulse of emission is examined.

It will be seen that at point t_0 at the commencement of the phenomenon, electrons of varying speed are emitted, the slope of the curve representing speed (distance traversed over time). The slower moving ones all return to the cathode by the time t' is reached, some of the slower ones arriving back

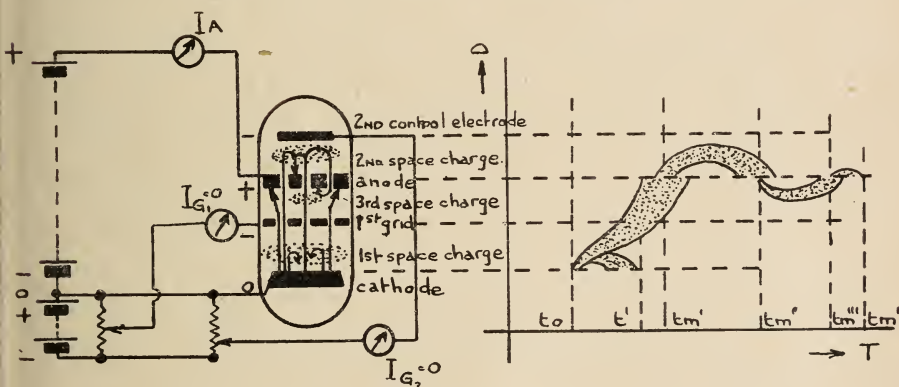


Fig. 2. Space-charges and Transit Time in Multi-grid Valve.

at the cathode even earlier. The faster ones, however, approach the grid and still continue to rise, and arrive ultimately at the anode at a varying speed, every electron arriving there by t'' ; the mean transit time, however, for the entire anode current pulse is t_m .

Having explained this method of notation and illustration in the simple case, let us examine Fig. 2, when we assume the anode to be perforated or to be of a grid-like structure, and to have beyond it a further electrode, which for the moment we will consider to be at a potential at which it will neither attract nor repel electrons. In this case any electron flying towards a gap in the anode will fly through this gap, having reached its maximum velocity in the moment of transit, shown on the right-hand diagram of Fig. 2 at t_m' ; the anode will have acted as an accelerator to the electron while it was approaching from the cathode, but as soon as it passes through the gap in the anode the latter will act as a brake or decelerator, reducing the forward

velocity of the electron to zero. Then the electron will be re-accelerated in the opposite direction until it reaches the anode again at t_m'' .

Space Charge Coupling

The quantity of electrons in the second space charge of a multi-grid valve, between the accelerator and second control grid or "virtual cathode" of the second control grid is a direct function of the voltage which existed on the first control grid a short instant of time before.

This time interval is the *transit time* of the electrons passing from the cathode space charge to the "virtual cathode" space charge. The transit time depends upon voltage and circuit constants, and is of the order of 10^{-7} to 10^{-8} seconds.

If the quantity of electrons in the virtual cathode increases, and so occupies more space, then these electrons approach the second control grid. Conversely, if the quantity decreases, the virtual cathode recedes from the second control grid.

This approaching and receding of a cloud of negatively-charged electrons in the proximity of a negative control grid will cause a grid current to flow in and out of the grid lead in sympathy with the motion of the electron cloud.

Second Space Charge

If the second control grid, lying between the two accelerators, has such a high negative potential as to cut off the current completely from the second accelerator—and consequently the main anode—then all electrons entering the virtual cathode of the second control grid must become decelerated to zero forward velocity by the second control grid.

These electrons then become re-accelerated in a backward direction by the first accelerator, and are absorbed by the latter, appearing in the accelerator grid lead as total constant accelerator current. This re-acceleration in a backward direction must, of necessity, bring the returning electrons through the meshes of the first accelerator, back into the space between the first accelerator and first control grid. Here they become decelerated again by the repulsion of the negative charge on the first control grid, and again reach a zero velocity.

This means that a new space charge is formed in the immediate proximity of the first control grid by the action of large negative voltages on the second control grid. If we consider the dynamic relationship of the conditions, it will become clear that voltages in the second control grid can cause "space charge coupling" to the first control grid just as above in the other more obvious direction.

Kinetic Grid Current Coupling

If we consider the case where a sufficiently large radio-frequency oscillating voltage applied to the second control grid is increased to its negative peak amplitude, approaching the anode "cut-off" value, and producing a rapidly increasing "extra space charge" as just described, it is clear that as the anode and second accelerator currents decrease, so the extra space charge gets larger and moves towards the first control grid.

The frequency chosen must be high, between 10 and 100 Mc/s., commensurate with the time it takes to re-accelerate electrons from the virtual cathode and to obtain full speed of transit in a reverse direction through the meshes of the first accelerator; then the velocity reached by some of the returning electrons, at the moment the anode current is completely cut off, is sufficient to drive them beyond the extra space charge into the negative first control grid.

The kinetic energy of these re-accelerated electrons must be quite considerable, as can be ascertained by measuring with a D.C. microammeter through a decoupling circuit included in the first control grid. To suppress this kinetic grid current to zero, the negative bias of the first control grid has to be considerably increased beyond the usual voltage necessary under static conditions to reduce normal static forward grid current to zero.

It should be noted that the kinetic grid current has the same direction of flow as forward grid current. The kinetic energy of these electrons appears to increase with the square of the driving frequency and with the square of the signal amplitude, within the limits observed.

The "Phasitron" *

This kinetic grid current phenomenon is applied to advantageous uses in special "Phasitron" devices, capable of use in phase and frequency modulation circuits as demodulators, phase-angle or frequency deviation indicators.

The first control grid circuit has included in it a resonant or reactive network, which is driven at the oscillator frequency applied to the second control grid by the arrival of kinetic grid current in pulses of energy every time the second control grid voltage is negative beyond anode current cut-off.

The resultant anode current is at a maximum when the two control grids are in phase, and is at a minimum when they are out of phase. When the circuit attached to the first control grid is resonant, the two control grids are in effect in quadrature, as viewed from the anode, and taking into account the transit time through the whole valve system. The anode current has a mean value which is about the same as would flow if both control grids were at approximately a static mid-point bias.

This type of valve in such a circuit has an anode current :

$$I_a = K(E_{g1} \times E_{g3}) \cos \phi,$$

which is directly proportional to the phase angle.

Demodulation Circuit

A practical application of this principle is shown in Fig. 3. If a resonant circuit is connected to grid 1 of a multi-grid valve, grid 2 acting as a positive accelerator, grid 3 having a high frequency oscillation of say 10 megacycles or more impressed upon it, the "kinetic electrons" reaching the first grid after grid 3 approaches its own cut-off potential will cause a uni-directional high impedance coupling between the oscillation on grid 3 and resonant circuit connected to grid 1, which will excite the resonant circuit and cause it to oscillate, this causing grid 1 to follow an approximately sinusoidal voltage sequence. This coupling is very much greater than if it were due only to the capacity coupling between these grids, which is only of the order of 0.1 pF. The smaller the damping on this circuit, *i.e.*, the higher the Q of the circuit,

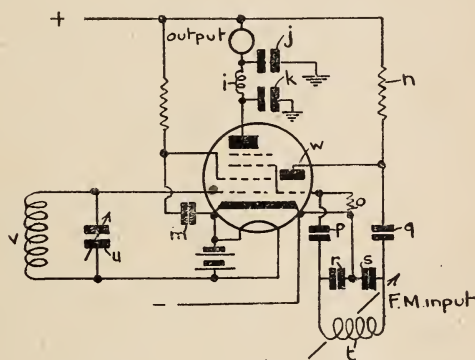


Fig. 3. Basic Circuit of "Phasitron."

* The term "Phasitron," in the sense used in this paper, should not be confused with the later use of the term in America to describe a new type of F.M. transmitting valve.

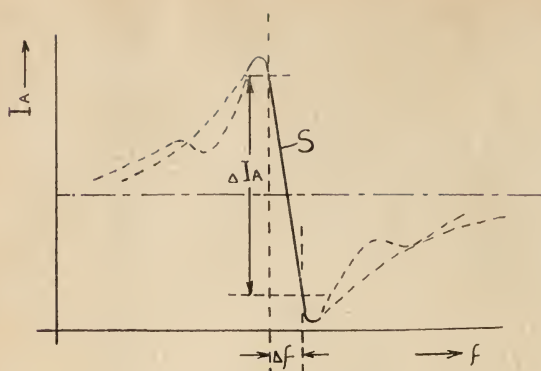


Fig. 4. Characteristic of Demodulating Circuit.

of extremely high efficiency, as shown in Fig. 4, in which the slope of the anode current change to change in frequency is proportional to the square of the Q multiplied by the square of the voltage, multiplied by the fundamental frequency raised to a power which in the frequencies between 10 and 120 megacycles approximates to the square.

An animated diagram sound film was then shown which illustrated the principles of phase modulation and demodulation by means of a wave motion analogy. This is summarised in Fig. 6.

III. AN EXPERIMENTAL MICROPHONE SYSTEM

D. A. Ball, A.M.Brit.I.R.E.*

THE circuit diagram of the "Phasitron," as applied to the requirements of a small condenser microphone, is shown in Fig. 5. The experimental apparatus is in two parts, the transducer consisting of a tubular housing 1 inch in diameter which contains an RK2 microphone, as supplied by Film and Equipments, Ltd., together with a built-in oscillator stage; and the second unit which contains a frequency doubler stage, a "Phasitron," and an output transformer to match into a standard 200 ohm network.

Construction of Transducer

Dealing first with the transducer, the microphone was chosen as the most advanced design obtainable and had the lowest capacitance. It has a capacity of 43 pF., which determines the oscillator frequency to some extent. As a result of experiments, we chose 17 Mc/s. as being the best from the microphone point of view, although from the "Phasitron" efficiency angle 40 Mc/s. would have been more favourable.

The oscillator valve employed is a "Hivac" CV99(UD51), a filament type valve chosen because we wished to supply the necessary voltages through a cable the length of which could be variable. In fact, we have no difficulty with voltage supplies working with cables of any length up to 150 feet.

One or two other valves should be suitable, such as the Raytheon CK.512A, having .625 v. 20 mA. filament, low microphonic type, .28 in. diameter. Other types are Mullard DF70, DL71, DL72, and Tungram DLL102, but these have not yet been tried.

Choice of Cable

A braided twin polythene cable has been chosen for the radio frequency

the more truly sinusoidal becomes its oscillation, although it is caused by periodic pulses as described above. By suitably adjusting the inductance and capacitance of the tuned circuit one can vary the phase of the first control grid A.C. voltage with reference to the second control grid A.C. voltage.

Response to Phase Deviations

Clearly this arrangement forms a demodulator of a frequency modulated carrier.

*Sargrove Electronics, Ltd.

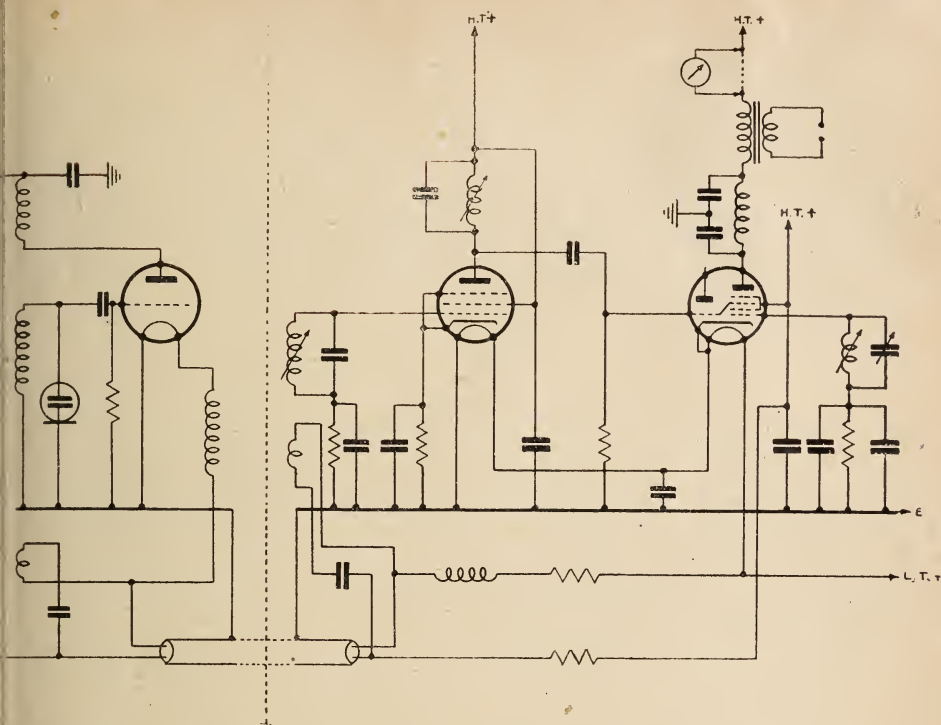


Fig. 5. Practical Circuit of "Phasitron."

link between the microphone unit and the "Phasitron" unit. Such a cable, when properly terminated, is not subject to standing waves which would introduce losses in the system, and has been arranged to carry the filament and H.T. voltage for the oscillator, in addition to the oscillator output.

Such cable is widely used in radio work, and the formulae for determining impedances in such conductors are as follows :

Co-axial cable :

$$Z_o = \frac{138}{\sqrt{K}} \log_{10} \frac{D}{d}$$

where D = I.D. of outer ;
 d = O.D. of inner.

Twin Parallel :

$$Z_o = \frac{276}{\sqrt{K}} \log_{10} \frac{2S}{d}$$

where d = diameter of conductor ;
 S = spacing.

Screened Twin :

$$Z_o = \frac{276}{\sqrt{K}} \log_{10} \left(2r \frac{1-R^2}{1+R^2} \right)$$

where D = I.D. of shield ;
 d = diameter of conductor ;
 S = spacing ;
 $R = \frac{S}{D}$
 $r = \frac{S}{d}$

The conductors in the cable are twisted, and in consequence, standing

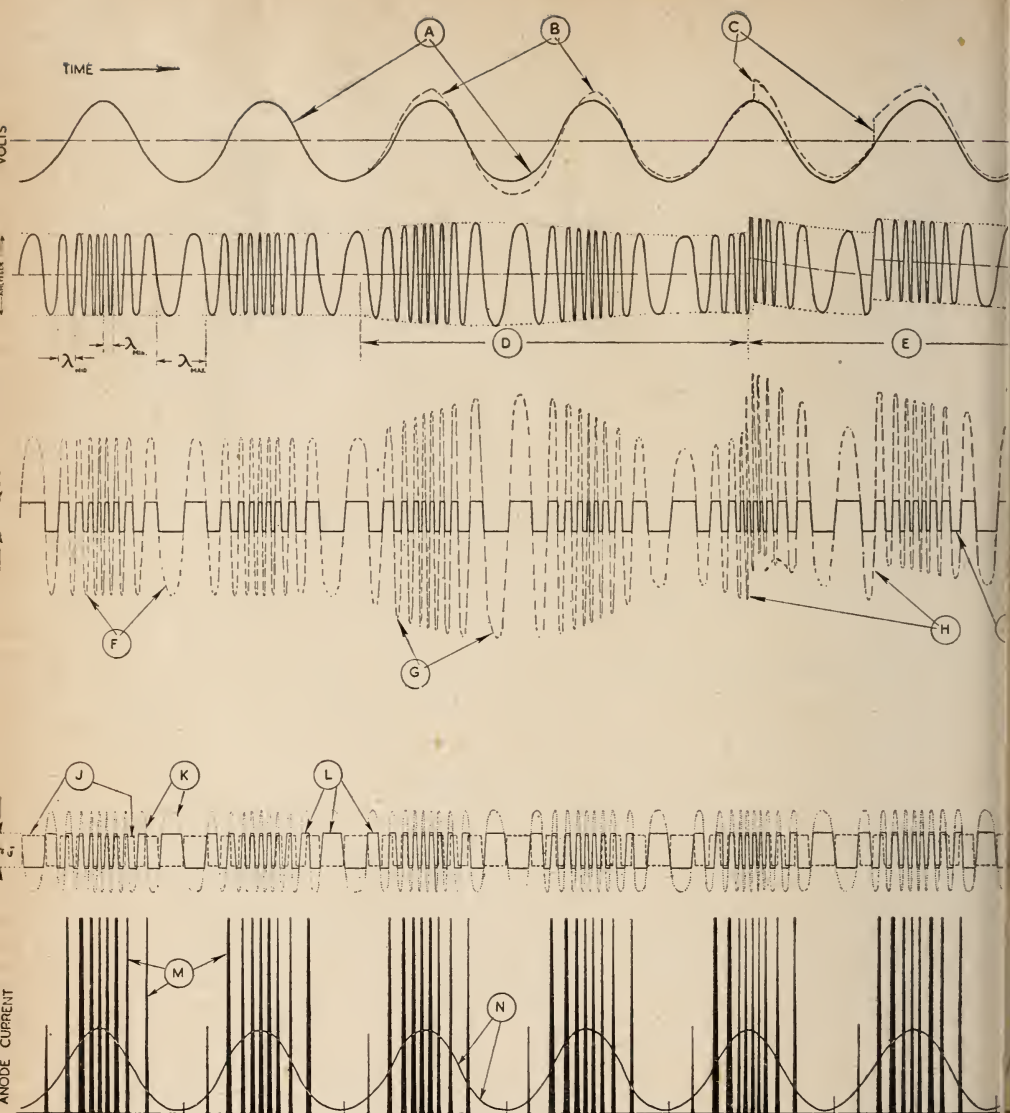


Fig. 6. Conditions occurring in "Phasitron" System.
(All these waves are referred to the same Time scale.)

- A. Audio Frequency Wave. Immediately below this is shown a high frequency wave carrying the audio waveform in the form of phase modulation. Thus, if λ_{mid} represents the mean wavelength, deviation takes place between λ_{min} and λ_{max} at the frequency of the original audio wave.
- B. Effect of mains hum interference on an A.F. System.
- C. Effect of two transient interference pulses on an A.F. System.
- D. Effect of hum interference on phase modulated oscillator, causing amplitude modulation.
- E. Effect of transient interference upon the whole phase-modulated system, including the cable. (Although this is not amplitude modulation, if it were demodulated by a normal detector, it would be indistinguishable from amplitude modulation.)
- F. Showing time interval without interference; after passing through a radio-frequency amplifier the signal is an amplified replica E.
- G. Introducing hum interference.
- H. Transient Interference.
- J. The limiter action of the input grid G3 of the "Phasitron" as referred to the anode current, limits the peaks of the signal to a constant and much smaller amplitude, considerably reducing the effects of interference which is essentially a variation in amplitude.
- K. Wave at "J" is reproduced here as a broken line and its negative going edge produces the kinetic grid current in this resonant circuit connected to G1 of the "Phasitron." This oscillates as a phase-modulated radio frequency, shown as a dotted line "K," positioned in time as viewed from the anode.
- L. The amplitude limiter action of G1 of the "Phasitron" squares this wave to the full line shown at L.
- N. Coincidences of positive going pulses of waves "J" and "L" produce large pulses of anode current shown at "M." The low-pass filter contained in the "Phasitron" anode current integrates these into the audio-frequency wave N without the need of a detector. This corresponds to the original sound signal A with a negligible proportion of interference signal B and C.

advantages, particularly in news-reel work, where trailing cables are often very inconvenient.

A radio link would permit the use of several microphones simultaneously on staggered frequencies, all received by one wide-band amplifier feeding separate "Phasitrons" for each transmitter, followed by a mixer network.

IV. PRACTICAL USE IN FILM PRODUCTION

Norman Leever, B.Sc., A.C.G.I., M.B.K.S.

THE high efficiency demodulator which has been described makes the use of the carrier wave system in connection with microphones and similar devices an economic proposition. The system is unconventional and of no small academic interest, but it is my task to consider its practical value in sound transmission and recording, with particular reference to film production.

The essential points arising out of the data we have presented are :

- (a) Very small changes in the resonant frequencies of one or both of the tuned circuits of the "Phasitron" cause large changes of anode current.
- (b) These changes may be caused by changes of either inductance or capacitance, but for most purposes it seems more desirable or convenient to vary the tuning capacitance.
- (c) For maximum sensitivity and efficiency it is desirable to use a carrier wave of very high frequency, certainly not less than 30 Mc/s. To maintain oscillation at such high frequencies, the "modulating" capacitor must be of very small value.
- (d) A high output level is possible without departing from linearity, *e.g.*, in the specimen described a frequency deviation of 80 Kc/s. at 31.15 Mc/s. would give about 3 volts peak output into a 200 ohm line.

Let us see how these factors affect microphone design.

Design of Condenser Microphones

Since the days when condenser microphones first came into general use in film studios, considerable development of this type has taken place, notably in Germany and England. Improved diaphragm materials and mounting have led to designs which are effectively aperiodic, and the reduction in physical size has shifted acoustic shadow and pressure doubling effects to the extreme upper limit of the useful audio spectrum. The original De Wente design of some 3 in. diameter compares, for instance, with the T.R.P. type RK2, which is only $\frac{3}{4}$ in. diameter.

The non-directional pressure operated type has been supplemented by new single units having bi-directional and cardioid polar response diagrams respectively, and the achievement of the cardioid characteristic in a single transducer will be of particular value in film production.

It should be noted that in general, the tendency has been for the physical size of the unit to be made as small as possible, or rather as small as is compatible with a convenient value of mean capacitance. While the percentage variation of capacitance is clearly the major factor in determining the sensitivity, the actual mean value is of importance in matching the unit into the grid circuit of an audio amplifier.

Conventional Microphone Circuits

Usually, the microphone is connected between the grid and cathode of a valve; it is polarised by a battery in series with a high resistance. In the unmodulated state, the electrodes are therefore at a potential difference equal to the voltage of the battery, and the quantity of electricity stored in

the microphone is given by $Q=Cv$ in the appropriate units. Having once supplied this charge, the battery and resistor could be disconnected, leaving Q a constant, when variation of capacitance C would produce variations of voltage which are inversely proportional.

In practice, the polarising resistor and battery are left connected in order to make good any leakage. The microphone then functions as a source of alternating voltage in series with a capacitor, and is resistance loaded. It is therefore "frequency conscious," having a falling output at low frequencies.

Specimen microphones of early type were found to have a capacitance of about 250 pF.; with a $7\frac{1}{2}$ megohm resistor the attenuation at 50 c/s. would therefore be about 6 db. If this attenuation is not to be exceeded, the latest designs having a capacitance of the order of 40 pF. should be used with a resistor of at least 40 megohms. These figures ignore the effect of the "breather" or vent in the microphone itself, which imposes an additional shunt leakage path (usually of very high resistance), and also any D.C. isolating network between microphone and valve.

We therefore find that the miniature trend in microphone design calls for a very high resistance input circuit to the first audio valve, while the requirement of low noise level calls for a low resistance input circuit. Any compromise cannot fully satisfy both conditions, and this tends to restrict further improvement in microphone design.

One method of dealing with this problem is to adopt a cathode follower circuit, in which the grid resistor is arranged to perform the function of the microphone polarising resistor. Its shunting effect on the microphone will be many times its D.C. resistance, due to negative feedback. It is preferable to feed the cathode follower into a buffer valve before passing the output to a long line, but a short length of cable is permissible between the cathode follower and the buffer stage for boom working.

Advantages of "Phasitron" Circuit

The "Phasitron" makes a bolder approach to the problem, and although there is not yet a large selection of quiet valves available, the grid resistance problem is dispensed with, and noise from resistances is negligible.

It makes possible a new approach to microphone design, for item (c) above indicates that increased efficiency will be obtained by further reduction in microphone capacitance. This can be achieved in existing designs by restricting the size of the fixed electrode to a small area opposite the centre of the diaphragm where movement of the latter is greatest. Indeed, the body of the microphone may be made entirely of low-loss insulation on which the tuning coil could be wound, the small microphone electrodes being at one end, and a small iron-dust trimming core at the other.

At present we are only using a minute fraction of the capabilities mentioned in (d), and this re-design of the microphone element as an integral H.F. tuned circuit and modulator should enable a far greater part of the linear characteristic to be utilised at normal sound levels, with a corresponding increase in sensitivity and reduction in noise level.

The radio link possibilities, too, are capable of valuable service in film production. Admittedly, studio operation calls for microphone positions which can best be provided by a boom, on which a cable presents no difficulty, but newsreel, location, and guide-track work is all carried on under conditions where cables are a real handicap.

Our experiments in this field lead us to believe that the short range radiating microphone with its local batteries and small folded dipole will be compact and inconspicuous enough to be used not only wherever an ordinary stand microphone is used, but also in positions where a microphone pick-up

is not practicable at present, due to difficulties in accommodating the cable.

In this way we foresee an increasing similarity between film and television newsreel production technique, embracing sound as well as vision.

In conclusion, we feel conscious that much of the material presented in this combined paper refers to improvements and developments at present beyond the scope of existing reproduction and even of many recording systems.

In film work we limit the recorded frequency range, primarily to suit the capabilities of our recording medium. The present limits will not always remain, however, when our knowledge of other systems, such as magnetic recording, is more complete, and our aim should be to extend the undistorted frequency range of recordings beyond the capabilities of reproducers.

The paper was followed by a demonstration film comprising a number of speech and musical items recorded on 35 mm. film by Leevers, Rich & Co., Ltd., during the period of testing.

DISCUSSION

Mr. D. W. BOSTON : What is the acoustic performance of the microphone, and how does the signal-noise ratio compare with other systems?

Mr. LEEVERS : The unit we are using gives a smooth response well towards 18 or 20 Kc/s, and due to its small physical size, the usual effects of pressure doubling are noticeable only at higher frequencies than usual, and may be minimised by using an acoustic screen facing the diaphragm.

Mr. W. S. BLAND : One trouble which would be avoided by using radio linkage is that co-axial cable will probably be too rigid to use on the boom. Also if you carry your low-frequency response down too far, you will get trouble with wind noise.

Your minute condenser transmitter has a practically non-directional characteristic, which is not desired these days.

Mr. BALL : The present cable has two strands of solid 24 s.w.g. cable, and is fairly flexible. The same type of cable can be obtained with flexible inner conductors; the diameter is $\frac{1}{4}$ in.

Mr. LEEVERS : The use of a limiter in a Phasitron circuit should enable us to insert short lengths of cabtyre to pass over the pulleys of a standard boom.

In regard to L.F. response, our point is that the Phasitron system makes available the full frequency range of the transducer, of which we can use whatever proportion we wish.

In regard to uni-directional response, I would draw your attention to the cardioid type condenser insert, manufactured by Neumann, which gives a very satisfactory cardioid characteristic in one transmitter. It is little larger than a pocket-watch.

Mr. J. E. JACOBS : As regards the R.F. link, it crosses my mind that carbon arcs might interfere. On the stability of the microphone circuit, it has to be an R.F. circuit which cannot be crystal controlled; does it need checking up often or can it be

left? Is any other possibility being considered, such as a gramophone pick-up?

Mr. SARGROVE : In regard to the noise from a carbon arc, we have not actually any experience, but provided the transmission change received is 3 db. greater than the noise level, you will get the signal over-riding the noise level. The effect of switching on and off hundreds of amperes in an adjacent cable has no effect.

In regard to stability, as Mr. Ball explained, there is plenty of room in the Phasitron system for drifts in the frequency band. We have been rather surprised that resetting has not been required; after the setting has been made, you can carry the microphone round, and the setting remains the same.

As regards a gramophone pick-up, Mr. Leevers has been experimenting with a design in which the gramophone needle is supported in a resilient rubber material, and its motion varies the capacity.

Mr. W. S. BLAND : I think the radio link is a very valuable feature of this system, and I foresee great possibilities in it for newsreel work. What would be the range of the transmitter?

Mr. BALL : With the system described, if we had a radiated output of $\frac{1}{4}$ -watt, which would be quite easily attained using deaf-aid batteries, I see no reason why distances in excess of a quarter of a mile should not be accomplished.

Mr. GRIFFITHS : The Society for the Radio Control of Models have been granted two wave-lengths.

Mr. BALL : The model control wave-lengths are not available for the transmission of intelligence, but it is to be hoped that an allocation similar to the "Business Radio" bands will be made.

Mr. R. H. CRICKS : At least three garages, to my knowledge, have transmitting licences for controlling their cars. One works over a range of 45 miles.

DISTRIBUTION AND MAINTENANCE OF RELEASE PRINTS

A. E. Ellis, M.B.K.S.*

Read to the B.K.S. Theatre Division on September 28th, 1947

ON its arrival from abroad, or from a British studio, a film is viewed, and any cuts necessary to make a film from abroad more suitable for the home market, or cuts suggested by the censor, are dealt with by the print manager. He is also responsible, in the case of a foreign film, for the making of the dupe negative and all the required release prints.

The release prints are handed over to the Despatch Department which, though run by the despatch manager, is controlled by the print manager.

Film Despatch

The aim of the Renters' Despatch Department is to see that a film is delivered in time for showing, and also in good running and screening condition. At present all films which are transported by road are sent from the various renters to the transport depot at Willesden. From here, films which are consigned to the Provinces are mostly carried overnight to the various Branch Offices, from which they are again forwarded by further local transports so as to reach their destinations, either the evening before, or on the morning of the day of showing.

Films for exhibition in the London area, which comprises the whole of London and the Home Counties, are sorted out and handed over to the various transport concerns which cover the whole of this area. With films which are to be crossed over from a theatre which finishes its showing on Wednesday night, for exhibition the following day, or on Saturday night for showing either Sunday or Monday, the procedure becomes rather involved. The transports bringing in shown films arrive throughout the early hours of the morning. These films are distributed to the renters' night staffs. Subjects which are required for re-despatch have to be re-labelled and handed over in sufficient time for the outgoing journey, on which all deliveries are made. This necessitates a staff of men experienced at cross-overs to be working at high pressure, so that everything required is checked in and got out again within a matter of five hours. Frequently the number of films handled by one renter overnight, particularly if news-reels are included, may run into hundreds.

The subject of direct cross-overs is one of which many projectionists have in the past made complaint. Ideally, every copy should be examined before being despatched, but the number of prints necessary for such a scheme would be almost double the number of prints at present used.

In the Provinces the system of transporting is similar to that in London, but on a smaller scale. The renters' Despatch and Examining Departments are very similar to those at their Head Offices, but although run as individual units, the despatch and repair departments are usually responsible to the print manager in London, whose duty it is to see that the Branches operate as efficiently as possible. Damaged prints are forwarded from Branches for inspection in London, where reprints, cleaning, etc., are undertaken, and from which reports are made to offending exhibitors.

"Green" Prints

When a film reaches a theatre for showing it is taken for granted that it is free of faults likely to cause trouble whilst it is projected. Provided a film

*Print Manager, Pathé Pictures, Ltd.

has been correctly dried in processing and the perforations have regained their proper pitch, there should be no difficulty in running it through the projector.

Green prints still cause piling up of emulsion, due to the emulsion being soft, but most laboratories wax the perforation margin so that a film can make its first few runs free of trouble. Of the many runs in the life of a print, its first runs are the most exacting; nevertheless, provided a film is waxed before its release, damage due to greenness is very rare.

"Doubling-up" Reels

A very common practice in projection rooms is what is known as the "doubling" of reels so as to reduce the number of change-overs; this is where mutilation creeps in. If a film is in 8 or more reels, each of from 750 to 1,000 feet, reels 1 and 2 are joined into one large reel, other reels of the film being similarly treated. The end title of reel 1 and the front title of reel 2 are removed, and the two reels are then joined together. After the film's 3- or 6-day run these large reels are "broken up," and the front and end titles should be replaced in the exact place from which they were removed, with the loss of, at the most, one frame of picture.

This procedure sounds very simple, but in practice it does not work out so well. Frequently, titles are not replaced—sometimes part titles are put on to wrong reels—often titles are badly joined, necessitating the removal of bad joins, with the consequent loss of more frames, so that after a few runs the ends and fronts of some reels begin to show quite a serious loss of footage, to the obvious detriment of a film's presentation.

At the ends of all reels there are standardised change-over marks—small dots in the right-hand corner of the frame. Many projectionists deem themselves capable of improving these cues.

The cure for this type of mutilation is, of course, what is known as the Double Reel. The removal of end titles and leaders of the following reels for doubling in the projection room is eliminated—the loss of footage at the ends and fronts of reels is eliminated, joining (and bad joining does cause a great deal of mutilation) is eliminated, and an enormous amount of time and temper is saved.

The Society, it is worthy to note, has made successful endeavours in bringing to the notice of the industry the benefits of the doubled reel*, and the technicians of many of the renters are doing their utmost to release reels of greater lengths, in an effort to reduce mutilation.

Film Damage

Torn and strained perforations are another of the many items which come under the heading of mutilation. The causes of this type of damage are many, but are traced generally to over-tight gates, worn sprocket wheels, fierce take-ups, dirty skates or gate runners, and badly made film joins. Many hundreds of thousands of feet of film have been rendered useless by bad joins—mostly joins which are made out of correct alignment. Many films have been badly strained from a faulty join down to the end of the reel involved. Although film splicing by hand is really a very simple matter, a minority of projection room personnel seem to have mastered this simple art, and it is strongly recommended that a good joining machine be installed in theatre re-winding rooms as part of the standard equipment; particularly, there should also be a supply of good quality film cement.

Oil, without which no projector would run for long, is another source of annoyance to those who have to handle film. Oil is mostly squirted on to film by accident, but often by design, as a means of preventing emulsion from adhering to runners. Oil may prevent this type of damage, but oil on film

*A British Standard Specification for a 2,000 ft. reel will shortly be issued

encourages dirt to adhere. Furthermore, an oily film is very difficult to re-wind, and when plated off for return to the renters, or for direct cross-over, the edges become "proud," and frequently many feet suffer broken perforations, necessitating their removal.

Causes of Film Scratching

Scratching is the damage which annoys the picturegoer most, for it can assault the eye and ear. More films are replaced on account of deep scratches than any other kind of mutilation. Sound tracks suffer such deep scoring as to mar sound reproduction, owing to the noise created by the broken edges.

The tragedy of scratching is that it should never happen. Projectors are designed so that the inch width of film, which carries the picture and sound track, does not come into contact with metal. Scratches on either surface of film are, therefore, the result of its being brought into contact with some foreign material, which should not be on the projector. Thorough cleanliness is the greatest eliminator of scratches as far as the projector is concerned—careful and accurate re-winding, the preventer in the re-wind room.

So far, the most prominent of known mutilations have been mentioned, but there are other ways in which films are damaged. Inefficient packing is responsible for a considerable amount of anxiety, as are the reels which are not rewound but taken from a split spool with its large centre.

Renters' Care of Prints

To combat mutilation the renters have their own examining staffs, who, on discovering damage, make a lengthy report, which reaches the print manager, who decides on the course to be taken to rectify the damage. If minor scratches are apparent, films are subjected to treatment which can eliminate scratches on the celluloid side if not too deep. If scratches are so deep on the emulsion side as to cause further complaint, reprints are put in hand. Should the damage be due to strained perforations, which it is obvious will break down after one or two runs, replacements are also made.

Films which become saturated with oil have to be cleaned, as these oily films invariably carry with them a large amount of dirt. Frequently, where small reels are used, reprints have to be inserted at the beginning and end of the reel in an endeavour to maintain the film's continuity; also new standard leaders have to be placed on the fronts of reels owing to cuts.

The amount of film stock used in making reprints and leaders—including the replacement of old "part" titles—in the course of a year amounts to a staggering number of feet, most of which need not have been used for this purpose had the films been handled with their due care. Some renters use as much as a quarter of a million of feet of spacing in course of a year.

There are occasions when films are damaged in transit; although it is then expected of the renter to deal with the problem, actually the renter's liability ends once a film has been handed over to the exhibitor's nominated transporter—for it is the exhibitor who employs the transports, other than those which carry films on the trunk services on behalf of the renters.

Print Managers' Committee

Some while ago, on account of the great increase in mutilation, the British Kinematograph Society formed a Committee which represented every side of the industry, to make recommendations for dealing with this problem. After various meetings the lengthy report of this Committee, which had the Society's President as its Chairman, was forwarded to the Cinematograph Exhibitors' Association and the Kinematograph Renters' Society.

As a result, the Kinematograph Renters' Society formed a Mutilation Committee comprising the Print Managers of its member companies. This

Committee reports damage and mutilation by exhibitors to the K.R.S., who deal with an offending exhibitor after a number of complaints against him.

Before this Committee was formed, one exhibitor could easily have damaged the property of several renters without any of these renters being aware that wholesale mutilation was taking place. Now, any exhibitor responsible for damage is tracked immediately. The number of complaints laid before the K.R.S. has been very high, a total of 237 from April to September of this year, and it is felt that the method now adopted will eventually be able to effect a great reduction in the amount of mutilation taking place.

Exhibitor and Projectionist

As far as exhibitors are concerned, it is known that instructions have been issued pointing out the seriousness of mutilation from their angle, and some of the circuits are taking drastic action when they find their staff responsible through carelessness for mutilation. This has the effect of reports being made on the condition of a film on its receipt, but unfortunately, renters are now receiving reports which are not as honest as they might be.

If, at any time, a projectionist has been responsible for damage, he should be honest and sensible enough to report the matter immediately to the owners of the film damaged, when in most cases the renter will do what he can to be fair. The man who damages a film and returns it in the hope that it will not be discovered is very foolish, as it is obvious the renters will not be in the least lenient to him.

The renter's difficulties are very much tied up with the exhibitor and the projectionist. I ask projectionists not to entrust the examining and re-winding to the re-wind boy until they are certain he is well trained, and that he can make a satisfactory join. When a film is rewound it should be run emulsion side up, so that scratches can be detected. Projectors must be thoroughly cleaned after each reel has been run. A few feet of black spacing should be made into a loop and run through the projector a few times, and carefully examined for scratches or torn perforations.

DISCUSSION

MR. R. PULMAN: Can we, on the exhibiting side, learn from the renters' examination departments—for instance, about the equipment used?

THE AUTHOR: Some renters use flat rewinders; I prefer the upright type, similar to that used in the rewind room, with a 15 in. plate.

MR. R. PULMAN: There are certain renters who do not treat prints before they are sent to the theatres, causing trouble due to emulsion pick-up. Can that be put down to the fact that the copies are not stored long enough?

THE AUTHOR: Ideally films should be left on the shelf for a week or two after printing. If the stock were in heated film vaults, it would be an advantage. By waxing the perforation margins, we do eliminate much of the piling up of emulsion. The effect of the "Peerless" process is that stock is pre-matured before showing.

MR. S. T. PERRY: The majority of damage is not caused on the projectors, but on the rewinder. In the rewind room there is usually insufficient light over the rewind bench; nine times out of ten the

two ends of the rewinder are out of alignment; spools are fragile and require careful handling. I would like to see a modern rewind bench in all rewind rooms; a joining press should be standard equipment.

MR. R. H. CRICKS: While I agree that every rewind room should be equipped with a joining press, the complaint of so many projectionists that the presses available will not give sufficient pressure upon the film, is fully justified.

The projectors of laboratories are usually fitted with felt gate runners. These definitely prevent scratching, but of course, the felts require frequent renewal.

MR. P. W. ALSTON: In the case of damage, is nobody sent to try to find the actual cause?

MR. R. H. CRICKS: Would there not be scope for the appointment in the larger towns of an independent expert—say one of the leading projectionists—who would be instructed to call to investigate instances of damage?

THE AUTHOR: We have been discussing that in the K.R.S. Print Managers' Committee.

THE SCOPE OF THE 16mm. FILM

Symposium presented to the B.K.S. Sub-standard Film Division on October 1st, 1947

I. EDUCATION

A. Russell Borland, M.A., M.B.K.S.*

IN many respects the film is a unique means of education. It can provide visual illustrations of moving subjects; it can speed up or retard movement; it can bring life to the classroom, and thus enlarge the experience of pupils.

Its disadvantages are that it is relatively expensive, that it requires fairly complicated apparatus; few teachers as yet have experience of using modern visual aids; many children who are habitual attenders at kinemas have developed a passive attitude towards films—their intellectual faculties tend to be lulled.

In view of these disadvantages, rigid tests must be applied to the choice of subjects for educational films, and to the making of them. Two of the principal tests are: can the subject be illustrated as well by any other means? Is the subject naturally dynamic?

What is the present field of the educational film? Although there are several thousand educational films in existence, few are really suitable for the teacher's needs. Producers have so far concentrated on relatively few subjects: geography, biology, arts and crafts, English, mathematics, and history.

We are now engaged in exploring other fields. Films are, for instance, most necessary in the primary field, yet there is an almost complete absence of films suitable for this field. In the new post-primary schools the curricula are not yet fixed; visual aids do not meet the same opposition as in the grammar school. In the field of adult education the film has tremendous potentialities, and to a limited extent may take the place of lecturers.

DISCUSSION

Mr. G. A. JONES: I do not agree with Mr. Borland's view that the film is of least value in the more advanced stages. The field of application in the sixth forms, and in university teaching, has hardly been touched.

Mr. A. PEREIRA: There is a great opportunity for teachers to make local films of their districts.

THE AUTHOR: That is increasingly being recommended by local education committees.

II. PROPAGANDA AND ADVERTISING

E. S. Morden†

THERE are perfectly good films which are lying on shelves after only limited use. Why is this? It would appear that the large potential distribution for 16 mm. versions is not fully appreciated.

Audiences can be found in large numbers for 16 mm. films. One of the strong arguments in favour of non-theatrical distribution is that an audience in the kinema expects to be entertained, not informed, and there is automatic resistance to propaganda, however well intentioned; on the other hand, the 16 mm. show has not established itself by its claim to entertain, and its audiences are receptive to the message contained in the programme.

Let us examine the methods that are available for distributing films non-theatrically:

- (1) *Mobile 16 mm. Units.* These can travel to any community in the country, either urban or rural; audiences can be invited from the general public, or the programme can form part of a club evening or technical discussion.
- (2) *Daylight Vans.* These have a very useful function in putting over a story briefly, and are designed for constantly changing audiences in public places in the open air.

* British Instructional Films, Ltd.

† Sound Services, Ltd.

- (3) *Continuous Loop Attachments.* Mounted in a cabinet, these have a field of usefulness similar to the daylight van, but indoors.
- (4) *Portable Projection Equipments.* The projector and small compact screen, used to project a sales film in a buyer's office, is a sales aid used in the United States, but only to a limited extent in this country.
- (5) *16 mm. Exhibitors.* Many of these would be receptive to the idea of the inclusion in their programmes of suitable advertising films or films on sociological subjects; they are of doubtful value unless they can be brought together, since it would not be practicable to deal with individual operators.
- (6) *Libraries.* Equipment owners form an ever increasing field for those with films to lend; the equipment owner, however, exercises a great deal of discrimination in his selection of films.

The facilities available are, therefore, most comprehensive, and in certain directions a high degree of selectivity of audiences is possible. But films must have the right appeal if a distribution is to be successful; in other words, films must be planned, keeping in mind the types of audience to which it is desired to show them.

Some commercial subjects cannot economically be put over by film. It might be worth making a film of some large industrial plant with only a limited audience in mind, but a film about some product of little intrinsic value for showing to small retailer buyers would not be justified, because worthwhile audiences could never be assembled, and the cost of distribution would be out of all proportion to the cost of the article to be sold.

DISCUSSION

Mr. RUSSELL BORLAND: Many education authorities completely ban anything savouring of advertising; other committees take the attitude that the teaching properties of a film may counterbalance its advertising content.

Mr. W. HISSEY: Might not more use be made of films for advertising overseas?

THE AUTHOR: I completely agree, but it is very difficult to get suitable films shown overseas.

Mr. H. S. HIND: It is the job of the British Council to get British films shown abroad.

Mr. N. LEEVERS: Much of the resistance of kinema audiences to advertising films has been inspired by the direct appeal type of film. I should prefer films of the more subtle type, such as prestige films, instructional films, or films of a more academic type, such as the large corporations are producing.

III. SCIENCE

G. A. Jones, M.A., F.R.P.S.*

IN scientific work the motion picture camera can be used for four purposes: investigation, recording, training and spreading information (*i.e.*, publicity).

The use for recording is similar to that in general photography. Often, however, less polished results are satisfactory and more adaptation of the equipment is needed. An experiment or a piece of new equipment in use can easily be recorded by means of 16 mm., but a properly made film is then desirable, even if it has not proper professional finish.

The chief drawbacks in this work at present are that no 16 mm. optical printers are available, that it is impossible to see the exact field photographed while the camera is running, that fades are often difficult to control in conventional cameras, that animation techniques are more difficult than with 35 mm. film, and that the film is more prone to show blemishes and dust spots as well as graininess. On the other hand, the equipment can be compact and light, easily adapted, relatively cheap to use (*e.g.*, by using reversal film) and colour is available without great trouble or expense.

In investigational work, some of these points are felt even more, whereas others are less important. Some special considerations hold. For example, a 16 mm. frame may be too small to record many instrument dials, but on

the other hand the equipment is compact and light for placing in a vehicle. In high-speed photography, 16 mm. is capable of higher frame speeds for particular mechanical conditions, *e.g.*, a linear speed of 100 feet per second gives 1,600 frames per second on 35 mm. but 4,000 on 16 mm. Sometimes the larger frame is needed to give adequate detail, but for optical reasons resolution is better on 16 mm. for a given picture frequency at speeds over 1,000 f.p.s.

In scientific investigational work it is not possible to compare 16 mm. directly with 35 mm., as each has its own fields of application to which the other cannot apply.

IV. ENTERTAINMENT

H. S. Hind, A.M.I.E.E., M.B.K.S.*

IT is not proposed at the moment to consider the 16 mm. kinema where it is in competition with 35 mm. kinemas; we will consider only the use of 16 mm. for entertainment in places where there is no 35 mm. kinema.

Taking the average village, the weekly film show probably has to be arranged in the village hall. Admittedly the film is old, but it has never been seen in these rural districts. The hall offers little comfort and warmth, and there may be a long walk, possibly along muddy unlit village roads. The maximum price of admission is probably 1s. 6d.

The exhibitor may reasonably hope that the hall will be filled. The operator will struggle through snow and flood in order not to disappoint his audience; he will give a show of a reasonably high standard, within the limitations of his equipment. He has to earn enough money at the door—after paying entertainment tax†—to provide a livelihood.

He is faced with the question: can he make a living out of showing entertainment films to villagers?

DISCUSSION

Mr. W. HISSEY: We know of quite a number of circuits operating, and they seem to find it profitable. I think they are probably 35 mm. people who have launched out into 16 mm. Thus they have got the knowledge and experience which so many operators lack.

Mr. R. H. CRICKS: There are two aspects, technical and commercial. Portable shows in war-time were not always too good, but apparatus has improved, and better films

are available. But there is the commercial aspect: the showman has to pay out a large proportion of his takings in film hire and tax. A circus in the village or a wet night will spoil the box-office, and may make it impossible to carry on.

Mr. FRIEZE: A big drawback in village shows is the lack of suitable halls. I believe one of the joys in going to the pictures is going to a large, palatial, well furnished hall.

*Sound Services, Ltd.

†The tax is now remitted in the case of exhibitions in halls seating not more than 200 persons, in a rural community whose population does not exceed 2,000 (effective date, 1st May, 1948).

BRITISH STANDARDS

The British Standards Institution have issued an addendum to their Yearbook, 1947. Listed among new and revised standards are:

- 777 : 1947. Film-strip and film slides. 2s.
- 1359 : 1947. Photographic conversion tables. 2s.
- 1379 : 1947. Bite of film clips. 1s.
- 1380 : 1947. Speed and exposure-index of photographic negative mat-

erial. Amendment PD 684. August, 1947. 2s.

1383 : 1947. Photo - electric exposure meters. 2s.

1384 : 1947. Measurements of photographic transmission density. 4s.

1404 : 1947. Screen brightness for the projection of 35-mm. film. 2s.

1405 : 1947. Measuring apparatus for photographic processing. 1s.

TECHNICAL ABSTRACTS

Most of the periodicals here abstracted may be seen in the Society's Library

APPLICATION OF PHOTOGRAPHY IN NAVAL RESEARCH.

J. H. Bell and W. R. Cronenwett, *J. Soc. Mot. Pic. Eng.*, Dec., 1947, p. 494.

The authors emphasise the great expansion in the use of photography during the war, and give a very bare outline of the main uses and the specialised techniques employed. They finish with a fairly detailed list of the directions in which the U.S. Navy wishes to see progress made.

M. V. H.

CALLIER Q OF VARIOUS MOTION PICTURE EMULSIONS.

J. C. Streiffert, *J. Soc. Mot. Pic. Eng.*, Dec., 1947, p. 506.

The author has constructed a densitometer which enables both specular and diffuse densities of a given area to be measured and hence their ratio, Callier's "Q factor," to be accurately determined. He presents data for various film stocks of the variation of Q with density. He emphasises that the effective value of density in the normal use of film depends on the optical system, and must not be confused with the visual diffuse density measured on a normal densitometer.

M. V. H.

A MICROPHONE TILTING DEVICE.

B. H. Denney and R. J. Carr, *J. Soc. Mot. Pic. Eng.*, Dec., 1947, p. 530.

Due to the relative positioning of the components in a cardioid type microphone, the vertical angle of acceptable pick-up is much narrower than the horizontal angle. Continuous control of vertical angle is therefore desirable, and on an existing boom it is arranged by a differential motion fitted to the extension windlass.

N. L.

SENSITIVITY OF PHOTOTUBES AS A FUNCTION OF COLOUR TEMPERATURE.

A. Cramwinckel, *J. Soc. Mot. Pic. Eng.*, Dec., 1947, p. 523.

A method of measuring photo-cell sensitivity in terms of colour temperature of the light source is described, and the results with four types of cell are presented in tabular form, together with surface brightness and energy output. Particular properties of the cells affecting sensitivity are discussed and conclusions drawn in relation to practical use.

N. L.

RECENT AMERICAN STANDARDS FOR 16- AND 8-MM. EMULSION POSITION.

J. Soc. Mot. Pic. Eng., Dec., 1947, p. 547.

In considering whether existing standards should be modified to suit present printing methods a survey describes the many alternative means of obtaining silent and sound prints in use, and the type of print obtainable in each case. It favours the retention of existing emulsion positions.

N. L.

PROBLEMS OF 8 MM. EQUIPMENT.

R. E. Lewis, T. J. Morgan, L. Thompson and J. T. Strohm, *J. Soc. Mot. Pic. Eng.*, Nov., 1947, pp. 439, 453, 463 and 468.

Of a series of papers on 8 mm. equipment and its problems, the first discusses the optical problems and indicates a method of testing dynamic resolution. The second relates to the mechanical design of the projector, while the third describes a sound-on-disc system in which synchronous starting is effected by means of a control track on the disc, which starts the projector motor. The last paper describes a combination sunshade and filter holder for the camera.

R. H. C.

CHECKING MOTION PICTURE APPARATUS SPEEDS.

C. T. Owlett, *J. Soc. Mot. Pic. Eng.*, Nov., 1947, p. 471.

In a device for measuring the speed of spring-driven cameras, light is passed through the aperture, and the obturations caused by the shutter influence a photo-cell, whose output frequency is indicated as camera speed.

R. H. C.

MULT-EFEX TITLER DEVICE.

J. T. Strohm, *J. Soc. Mot. Pic. Eng.*, Dec., 1947, p. 544.

Features of a titling device for sub-standard films are a special aligning device, and attachments for producing various effects.

R. H. C.

BOOK REVIEWS

THE ART OF THE FILM, by Ernest Lindgren. (George Allen & Unwin, Ltd., 16s.)

Mr. Lindgren modestly states that his book is an introduction to film appreciation. In the opinion of this reviewer it is all that and more—much more.

The making of a motion picture requires the active co-operation of a great number of specialists working together as a team. The functions of these specialists are described in chapters on the studio, the script, the film maker's tools, editing, photography, the use of sound, film music, and the art of the actor.

No other art form is so completely dependent upon public approbation. The level to which the motion picture attains is itself set by the public. This well written book, which I hope will be widely read, will help members of the public to express and understand their preference in film entertainment.

I. D. WRATTEN.

KINEMATOGRAPH YEAR BOOK, 1948. 688 pp. (London: Kinematograph Publications, Ltd., 20s.)

We have come to rely on this publication as an authoritative source of information covering the film trade in its broadest sense, and this year's edition is as comprehensive as ever.

The simple indexing system brings

quickly to hand concise data, much of it in tabular form, dealing with all sections of the trade, from film registration, renting and exhibition, right back to the source of the product in the film producing companies. A new section dealing with sub-standard film production and exhibition will be found of value not only to the sub-standard worker, but to all whose work brings them into contact with this recently developed field.

NORMAN LEEVERS.

VADE-MECUM DE L'OPERATEUR PROJECTIONNISTE. Vol. 1, by R. Aylmer, edited by G. Lechesne. 160 pp. (Nouvelles Editions Film et Technique. Paris: Fr. 460.)

The latest edition of this well-known textbook is published after the death of its original author. The present volume deals with theory; a second volume is to cover the practical aspects.

The term theory is used in a broad sense; a remarkable omission from such a book is the principles of electricity—the former edition contained an admirable survey of the electronic theory. The book is written in a colloquial style, which, while very readable, leads easily to factual misstatement; thus we are told that an accumulator is a reservoir which has to be filled with electricity.

R. H. CRICKS.

CO-OPERATION WITH A.F.I.T.E.C.

At the Council meeting on February 4th, proposals were agreed upon for establishing closer co-operation with l'Association Française des Ingénieurs et Techniciens du Cinéma. These proposals were the outcome of a discussion between the Chairman and Secretary of A.F.I.T.E.C., Messrs. R. Didée and Jean Vivié, and Mr. R. H. Cricks in Paris earlier this year. The proposals, which were presented to the Council, for the Foreign Relations Committee, by Mr. C. Cabirol, were as follows:

1. There should be a reciprocal exchange of Journals between the Officers of the two Societies. It was agreed that the B.K.S. should send one copy of *British Kinematography* to M. Vivié and two copies to M. Didée.
2. Each Society should have preferential opportunity for reprinting papers appearing in the other's Journal. In order to facilitate such arrangements it was agreed that proofs of all

material should be submitted and that photographs should be made available.

3. In order to ensure early interchange of information on technical matters, standardisation projects, etc., a monthly letter should be exchanged.
4. Members of either Society should be entitled reciprocally to membership of the other Society while in the country of the latter. Thus B.K.S. members travelling in France will inform the Secretary of their French address and the duration of their stay, and will then receive notices of A.F.I.T.E.C. meetings and copies of their Bulletin. Similarly, A.F.I.T.E.C. members in this country will receive notices of B.K.S. meetings and copies of *British Kinematography*.

The May meeting of the Council brought the news that the French Society had agreed to these terms of co-operation.

THE COUNCIL

Meeting of May 5th, 1948

Present : Messrs. W. M. Harcourt (*President*), A. W. Watkins (*Vice-President*), F. G. Gunn, R. B. Hartley, B. Honri, L. Knopp, A. G. D. West, I. D. Wratten (*Past President*), R. Pulman (*representing Theatre Division*), H. S. Hind (*representing Sub-standard Division*), and R. H. Cricks (*Secretary*).

New Officers and Council.—The election of Officers and Members of Council, and nomination of Divisional representatives were reported (*see inside back cover*). In accordance with a previous proposal, Mr. L. Knopp was appointed Deputy Vice-President. Mr. Harcourt recalled that at the Ordinary Meeting a new member had expressed the desire that Members of Council should be better known to the membership, and it had accordingly been arranged that photographs of Officers and Members of Council should appear in *British Kinematography*.

Executive Committee.—It was agreed that the Executive Committee should comprise the following : President, Vice-President, Deputy Vice-President, Immediate Past President, Hon. Secretary and Hon. Treasurer.

Income Tax.—In view of heavy payments in respect of income tax, further steps to ascertain the Society's liability were decided upon.

Secretaryship.—It was reported that Mr. W. L. Bevir was being engaged as Secretary, subject to a three months' probationary period.

Premises.—Difficulty was reported in obtaining suitable office accommodation.

Appointment of Committees.—A number of committees were re-appointed (*see inside back cover*). It was agreed that, owing to demands upon their time, officers should not normally be shown as members of committees, except when appointed chairmen.

Adjournment.—At this stage the meeting was adjourned until May 12th.

Adjourned Meeting of May 12th, 1948

Present : Messrs. W. M. Harcourt (*President*), A. W. Watkins (*Vice-President*), P. H. Bastie (*Hon. Treasurer*), F. G. Gunn, R. B. Hartley, B. Honri, A. G. D. West, I. D. Wratten (*Past President*), H. S. Hind (*representing Sub-standard Division*), R. H. Cricks (*Secretary*), and W. L. Bevir (*Acting Secretary*).

Premises.—Proposals for office accommodation were discussed.

Standing Orders.—Standing orders of Council for the year 1948/49 were agreed. It was confirmed that every committee should be asked to appoint an Hon. Secretary.

Co-operation with S.M.P.E.—It was reported that the arrangements for co-operation with the S.M.P.E. were to be ratified by that body at a meeting which was to have been held on May 10th.

Co-operation with A.F.I.T.E.C.—Correspondence was submitted from the Association Française des Ingénieurs et Techniciens du Cinéma, signifying their agreement to the terms of co-operation previously submitted.

Training of Projectionists.—Replies to enquiries addressed to the C.E.A. and the N.A.T.K.E., concerning proposed training schemes for projectionists, were considered.

Home Office Regulations.—The Committee considering the draft regulations under the Cinematograph Act was authorised to submit its findings to the Home Office, without prior reference to the Council.

Physical Society Exhibition.—The Society's participation in the Physical Society Exhibition was reviewed.

Report on Colour Terminology.—A report on Colour Terminology, prepared by the Physical Society Colour Group, was submitted, in the preparation of which Major Cornwell-Clyne, the Society's representative, had played a prominent part. Thanks were conveyed to him for his services.

B.S.I. Representatives.—It was agreed that Messrs. Oram and Cricks should represent the Society on the B.S.I. Cinematograph Industry Committee, in addition to Divisional representatives. The Theatre Division had nominated Mr. R. Pulman and the Sub-standard Division Mr. H. S. Hind; the Film Production Division Committee had not yet met. The need for greater publicity for standardisation matters was agreed.

Branches Committee.—Correspondence with the Manchester and Newcastle-on-Tyne Sections was reported. It was agreed that a Section be formed in Leeds. Activity in Glasgow was reported.

Film Production Division.—Thanks were conveyed to Mr. A. W. Watkins for the admirable arrangements made on the occasion of the visit of members to the M.G.M. Studios on May 8th.

Theatre Division.—Opposition was reported to the proposal to charge for refreshments at meetings.

Sub-standard Division.—Proposals for the co-ordination of meetings with the R.P.S. Kinematograph Section were reported.

EXECUTIVE COMMITTEE

Meeting of May 5th, 1948

Present : Messrs. W. M. Harcourt (*President*), A. W. Watkins (*Vice-President*), I. D. Wratten (*Past President*), and Miss S. M. Barlow (*Assistant Secretary*).

Elections.—The following were elected :—

NIGEL ANTHONY RACINE-JAQUES (Associate), Film Artist and Animator.

WILLIAM JAMES VARNEY (Associate), Paramount Theatre, Glasgow.

NORMAN CRAVEN (Associate), Regal Theatre, Bradford.

SEYMOUR JOHN WATERMAN (Associate), Plaza Cinema, Barry, Glamorgan.

ROY TULIP WHEATLEY (Member), RCA Photophone, Ltd.

ELIZABETH VIVIENNE EASTTY (Associate), Kay Carlton Hill Studios, N.W.8.

SIDNEY COLE (Member), Ealing Studios, Ltd.

NORMAN JOHN ADDISON (Member), A. Kershaw & Sons, Ltd.

DAVID TERRY ROGERS (Associate), Cavalier Films, Ltd.

NORMAN WALLACE (Member), Alhambra Theatre, Barnsley.

DAVID B. WILLIAMS (Associate), Freelance Journalist and Scenario Writer.

ANDRÉ CLÉMENT COUTANT (Associate), Société d'Etudes et de Réalisations Industrielles.

JAMES FOX (Associate), King's Cinema, Perth.

Transfers.—The undermentioned Student was transferred to Associateship :—

JOHN GRAHAM NOWELL, Film Studios (Manchester) Ltd.

THEATRE DIVISION

The annual general meeting of the Theatre Division was held on April 18th, 1948. The chairman, Mr. S. B. Swingler, presided, and submitted the following report :

Chairman's Report

In reviewing the activities of the Division over the last twelve months, it is pleasurable to be able to report that membership of the Division has increased considerably.

A large amount of work has been carried out by the Division as follows:

Home Office Regulations.—Messrs. Wratten, Knopp, Ricketts and Cricks, together with Mr. H. S. Hind representing the Sub-standard Division, are members of the Committee dealing with this important matter. Considerable time has been devoted to it, the results of which will not be known for some little time.

Film Mutilation Committee.—The Committee, consisting of Messrs. Wratten and Cricks, with representatives of the C.E.A. and K.R.S., and in addition Messrs. Perry and F. H. Woods (co-opted), is now beginning to bear fruit, and the first brochures are nearing completion.

British Standards Institute.—Messrs. J. Benson and Cricks, together with Messrs. P. Pilgrim and F. H. Woods representing the K.P.E.A., have been nominated by the B.S.I. as a Committee to deal with defining the terms used in the kinema.

Provincial Sections.—The Newcastle and Manchester Sections have during the year made steady progress. At Leeds, Glasgow, and Cardiff sections are in the process of being formed, and the first two have already held preliminary meetings. The Theatre Division Papers Sub-Committee has in the case of Newcastle and Manchester assisted in arranging a lecture programme during the past season, and the membership of these two Sections has increased almost to the point where they can become Branches under the new constitution now approved by the Council. In this expectation, the Council has now formed a Branches Committee, under the Chairmanship of the Deputy Vice-President, and including representatives of Divisions and of each Branch when formed.

I should like to take this opportunity of thanking all members of the Theatre Division Committee and the sub-Committees for their very valuable work. In particular I would like to express appreciation to Mr. Pulman and Mr. Cricks for their very active interest, and the results they have obtained with regard to the Provincial sections.

Lastly, I thank all members who are present at this meeting to-day. I cannot let this opportunity pass, however, without asking members of the Division to bring to the notice

of all projectionist members the details of these Sunday morning meetings, at which we should have a far greater attendance.

Again our thanks should be expressed to the Gaumont-British Picture Corporation for the continued use of their theatre, and to Mr. J. S. Abbott and his staff.

Committee of Division

Mr. Swingler reported the membership of the Committee for the coming year (*see British Kinematography*, May, p. 178), adding that no election had been necessary.

Mr. A. E. Ellis proposed a vote of thanks to the officers and committee. Dr. F. S. Hawkins, seconding, asked whether the holding of Sunday meetings was justified by the number of projectionists who attended. The chairman undertook that the choice of day for meetings, and proposals for increasing interest among projectionists, should be studied.

SUB-STANDARD FILM DIVISION

At the annual general meeting of the Sub-standard Film Division, held on April 7th, 1948, the chairman, Mr. H. S. Hind, submitted the following report :

Chairman's Report

During the past year the membership of the Division has continued to increase, and is now 204, made up of 126 Corporate Members, 63 Associates, and 15 Students. The success of a Division is not, however, measured merely in terms of its size, but upon the interest shown, and the support given, by its members. In this respect there is definite room for progress, and your Committee is particularly anxious to see an increase in the attendance at meetings. Suggestions from members of the Division, either on the subject matter of papers, or the arrangement and nature of meetings, will be welcomed.

Meetings.—Four meetings have been held, and each one has proved to be of great interest if the discussions which followed are an indication. Our programme ends to-day with an exhibition and demonstration of new equipment, and I am pleased to report that it is open to members of the R.P.S., with whom we are in close co-operation.

Physical Society Exhibition.—This year the Council has assumed responsibility for the running of this Exhibition, and formed a special Committee, which was largely composed of members of this Division. The Exhibition is open this week at South Kensington.

Next Year's Programme.—In arranging the programme for the coming year, your Committee has in mind the possibility of preparing short informal demonstrations or addresses immediately before the main paper. This will not only fill up what in some cases is an idle half-hour or so, but will enable us to cover subjects which are not sufficiently important in themselves to justify a separate paper.

Committees.—Finally, I should report that this Division has been fully represented on all Committees which had a bearing on the sub-standard size film or its application, notably the Committee discussing the draft Home Office regulations, and numerous committees of the British Standards Institution.

Election of Committee Members

The chairman reported that the election for two members of the Committee had not yet taken place. A vote of thanks was carried to the Wellcome Foundation, and to Miss F. Anthony and her staff.

Discussion

In response to the chairman's invitation, a number of constructive suggestions were brought forward. The desirability of a closer interest in 16 mm. production was agreed; the chairman pointed out, however, that television fell rather within the spheres of the other Divisions. It had been felt that the film-strip was rather within the province of the R.P.S.

Consideration was being given, the chairman informed another speaker, to the issue of a joint list of R.P.S. and other meetings. Replying to a question regarding the work of the B.S.I., Mr. Hind stated that the B.K.S. was working closely with the S.M.P.E. in the preparation of parallel standards. Another speaker asked that the Division should work to improve the quality of 16 mm. sound.

FILM PRODUCTION DIVISION

Objection was raised, at the annual general meeting of the Film Production Division held on May 5th, 1948, to the short notice given of the meeting, due to late publication of *British Kinematography*. It was decided, as the meeting was purely formal, to proceed with the business.

[Continued on page 214]



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KODAK

Election of Committee Members

Mr. Rex B. Hartley, Hon. Secretary, read the report of the scrutineers in the ballot for committee members, announcing that Messrs. G. Burgess, B. Honri, and B. C. Sewell had been elected.

Chairman's Report

Mr. A. W. Watkins, the chairman, submitted the following report :

The Divisional activities during the year have on the whole been most successful. The membership of the Division is as follows :

Corporate Members, 216 ; Associates, 120 ; Students, 31—Total 367.

In addition to three meetings of the Division and a joint meeting with the Television Society, five joint meetings have been arranged with the A.C.T. ; these meetings have been fully appreciated by A.C.T. members. The Division has again been asked by the Council to assume responsibility for any such meetings during the coming session.

Two members of the Committee whose services have been particularly valuable are Mr. Rex B. Hartley, the Hon. Secretary, and Mr. Baynham Honri. Thanks are also due to the Gaumont-British Picture Corporation, and to Mr. J. S. Abbott and his staff.

Discussion

Mr. W. S. Bland referred to the fact that certain papers had not adhered to the subject-matter indicated by their titles. The chairman assured him that steps were being taken to avoid a recurrence of such incidents, and Mr. W. M. Harcourt endorsed this statement.

In response to a suggestion by Mr. A. C. Snowden, Mr. I. D. Wratten urged that the regulations concerning attendance of non-members at meetings should be more fully implemented ; he mentioned that a charge for refreshments would in future be made.

Mr. T. S. Lyndon-Haynes spoke in appreciation of the joint meetings with the A.C.T., and other members agreed that they would serve as an encouragement to the senior grades within the A.C.T. to join the Society.

Vote of Thanks

Mr. W. M. Harcourt proposed a vote of thanks to the chairman and committee of the Division, which was seconded by Mr. Wratten.

LEEDS SECTION

At the May meeting of the Council the recommendation of the Branches Committee was agreed upon, that a new Section should be formed at Leeds. The first committee of this Section will consist of the following :

Messrs. C. E. Perry (*Chairman*), F. L. Furey (*Hon. Secretary*), H. B. Asher, R. S. Folland, L. Mannix, R. E. Jeffery, R. Robertson, and E. A. Seall. Mr. Furey's address is 7, Lofthouse Terrace, Leeds, 2.

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PERSONAL NEWS of MEMBERS

Members are urged to keep their fellow members conversant with their activities through the medium of British Kinematography.

W. Gilbert S. Davies has been appointed Hon. Secretary of the Barry Branch of the K.P.E.A.

E. Oram, following a business journey on the Continent, is travelling next month to the U.S.A.

MARCUS M. PULVER

Died February 27th, 1948

Mr. Pulver was well known for his work on the electrical side of the film industry. In the earliest days of the industry he built the first mobile generating set for outside location work. He was 67 years of age.

P. L. P.

EDGAR THORNE

Died May 22nd, 1948

Mr. Thorne had been with George Humphries & Co., Ltd., for several years. Prior to this he had been with the Olympic Kinematograph Laboratories, Ltd. He was 56 years of age.



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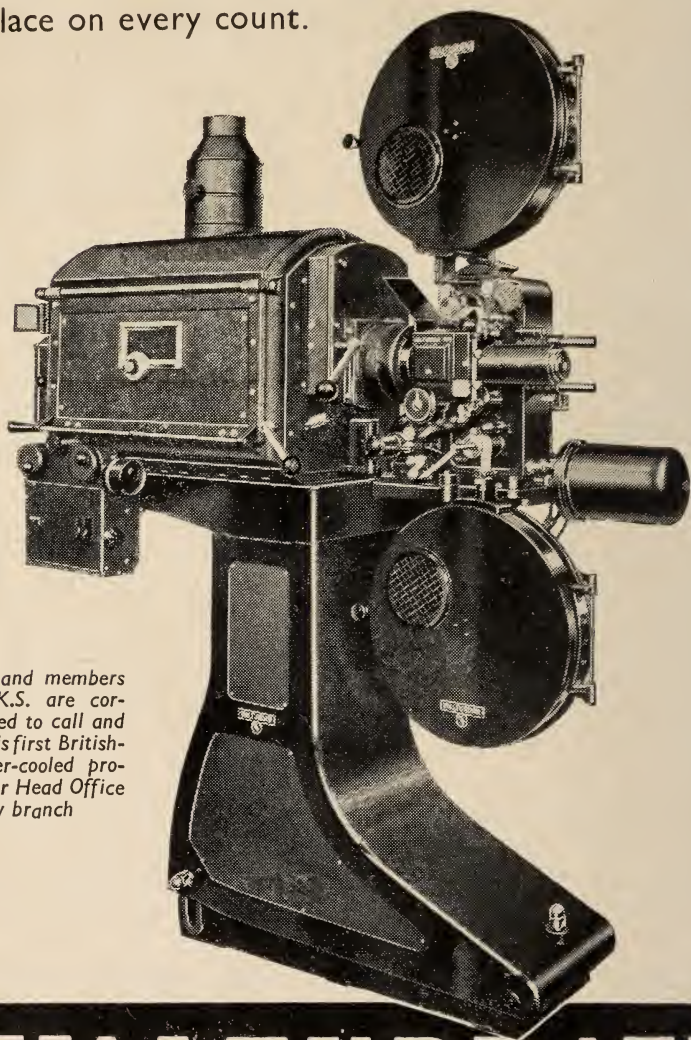
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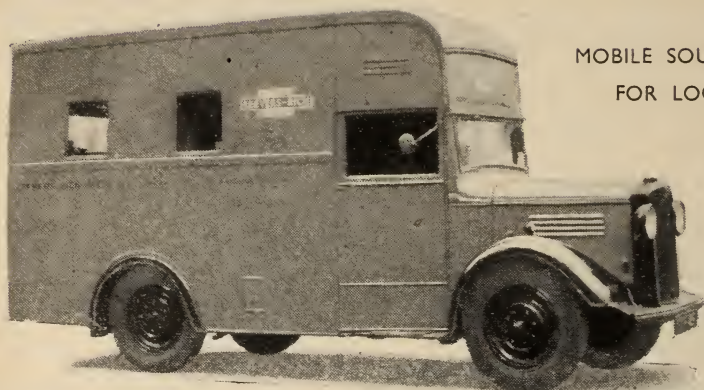
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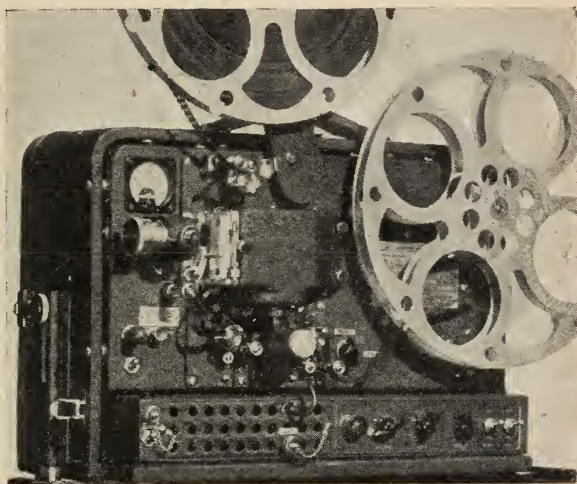
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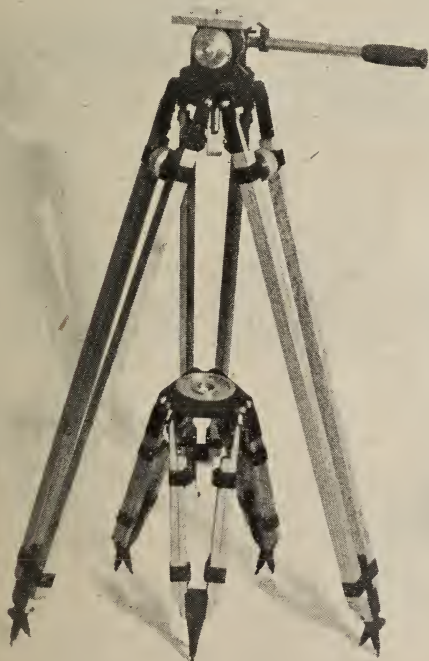
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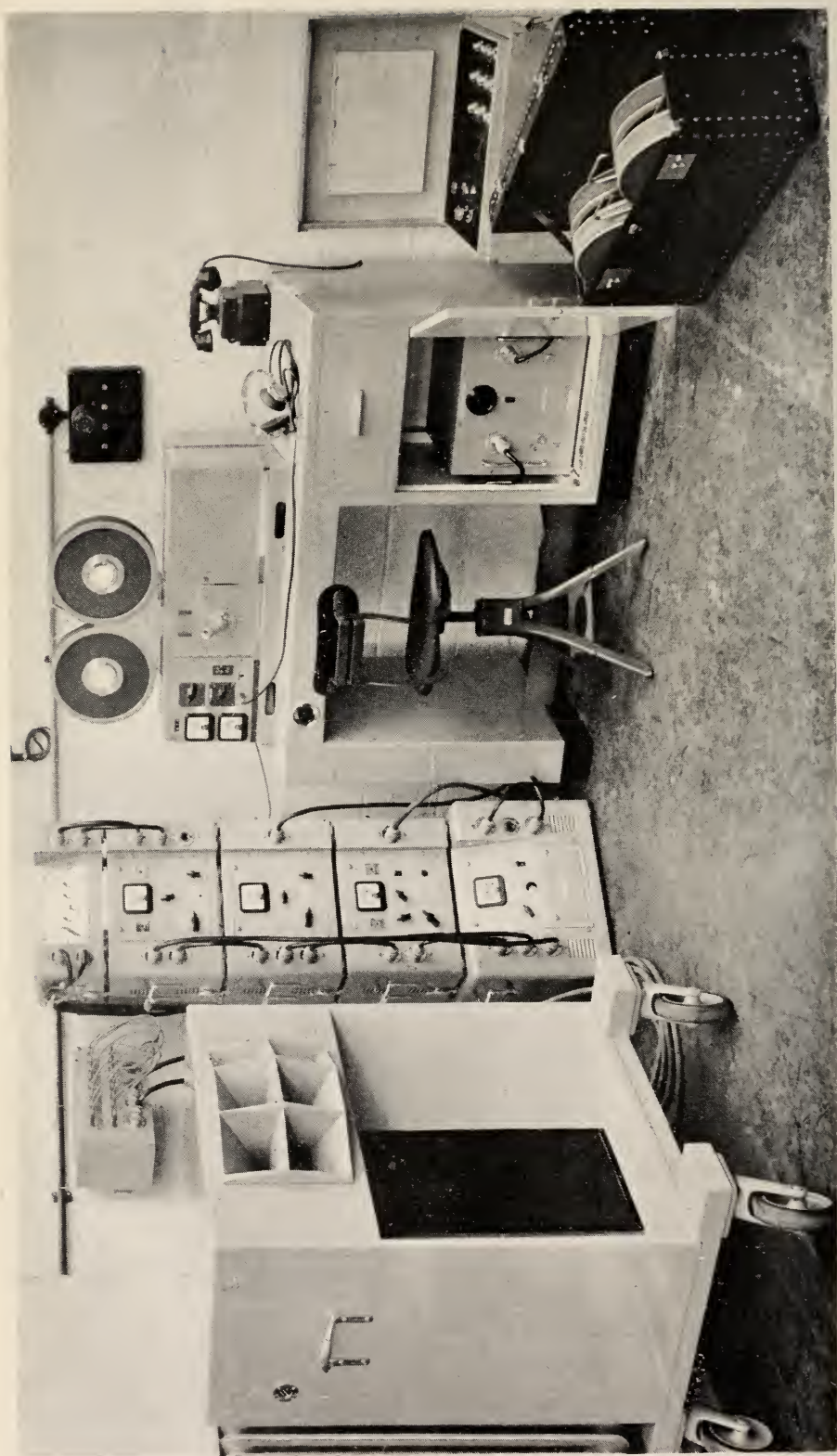
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VOLUME THIRTEEN, No. 1.

JULY, 1948

COLOUR VISION AND THE FILM INDUSTRY

W. D. Wright, A.R.C.S., D.Sc.*

Read to the British Kinematograph Society on April 14th, 1948.

A paper of an introductory nature was read by Dr. Wright to the B.K.S. Theatre Division on November 31st, 1947, in the course of which demonstrations were given of the additive and subtractive synthesis of light and of the effect of filters.

THE colour film, like any other artistic medium, has its technical limitations and imperfections, but colour photography is so complex that the artist is dependent on the technician to an unusual degree. Success in colour film production is likely to reach its highest level only when the artist and the technician have the most sympathetic understanding of the other's approach to the subject.

The account of the basic principles of three-colour reproduction given in Section I has been given in a very condensed form, since these matters have been discussed in detail elsewhere.

I. BASIC PRINCIPLES OF COLOUR REPRODUCTION.

Most processes of colour reproduction depend on the well-known visual phenomenon that colours can be matched by the additive mixture of three radiations; for various reasons these are generally chosen to be saturated red, green, and blue lights. This phenomenon is most easily understood on the assumption that in the retina there are light-sensitive receptors of three types, one type being most sensitive to light from the long wave end of the spectrum, the second type most sensitive to the medium waves, and the third type to the short waves. Details of the physiological processes underlying this conception are not fully understood, but as a working hypothesis it is quite satisfactory so far as colour photography is concerned.

From colour matching experiments it is possible to derive the spectral mixture curves which for any specified red, green and blue radiations, record the amounts of the three stimuli required to match the colours through the spectrum, and from which the amounts required to match any composite radiation can be calculated when the spectral composition of such a radiation is known. A typical set of curves is shown in Fig. 1, but when the qualities of the red, green and blue matching stimuli are changed, the same data will be represented by a different, but linearly related set of mixture curves.

*Technical Optics Section, Imperial College of Science and Technology

Three-colour Reproduction Process

In a three-colour reproduction process, the colour at each point of the reproduction is determined by the relative amounts of three radiations R, G and B present at the point in question. The intensities of R, G and B are determined, in colour photography, by the exposure of three negative emulsions to the object being photographed. The image of the original scene is focused on red-sensitive, green-sensitive and blue-sensitive emulsions, the emulsions subsequently being processed and printed as positives which control the brightness of the red, green and blue radiations at each point of the picture.

It should be emphasised that this principle applies to both the additive and subtractive methods of reproduction, since the three absorbing layers in the subtractive process serve in effect to control the intensities of the R, G and B components, as the descriptive names often used for these layers, namely minus red, minus green and minus blue, would indicate.

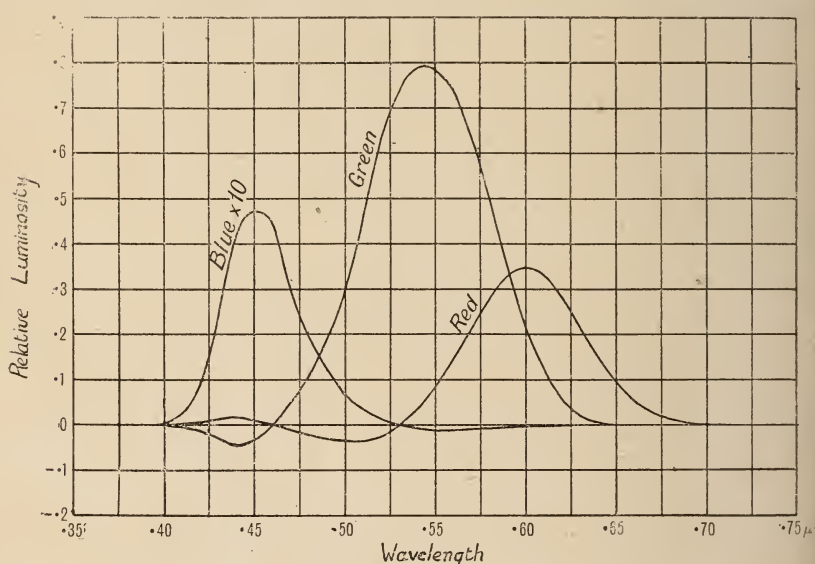


Fig. 1. A typical set of spectral curves.

The accuracy of colour reproduction depends on a number of factors, but if the photographic processing is such that a linear relation holds between the exposure of each of the separation negatives and the resulting intensities of R, G and B in the positive, then the spectral sensitivity curves of the separation negatives should theoretically correspond to the spectral mixture curves that would be obtained from visual colour matching experiments, using the R, G and B radiations of the positive reproduction process for the matching stimuli. Thus, once R, G and B have been chosen, the sensitivity requirements of the rest of the process are merely a matter of calculation on well established colorimetric principles. In practice, the application of these principles is extremely difficult; and considerable departures from the theoretically correct relations are possible without very serious distortion of the colour rendering.

Sources of Error

There is in any case a number of potential sources of error inherent in the photographic process, such as the non-linear characteristic curves, the

difficulty of securing identical gammas for the three processes, and, in the subtractive processes, gross departures of the minus red, green and blue dyes from absorbing media having the theoretically ideal spectral absorption characteristics. There are two major defects from which actual dyes are liable to suffer, namely, the tendency to absorb light in those parts of the spectrum where they should in theory be perfectly transmitting, and also a tendency for the actual qualities of the R, G and B radiations controlled by the three layers to vary according to the densities of each layer. The former defect can be partially compensated by masking techniques, at the cost of further elaboration of the process, while the latter can in some circumstances lead to the reproduction of more saturated colours than the simple theory would predict as possible.

The phenomenon of three-colour matching not only provides the basis of colour photography, but it also leads to the trichromatic system of colour

specification, in terms of which colours can be specified numerically, and on which, for example, the errors of colour reproduction can be recorded. In the international C.I.E. system, a colour is specified in terms of three reference stimuli X, Y and Z (corresponding to defined red, green and blue stimuli). The colour quality of a stimulus C can then be plotted on a chromaticity chart, Fig. 2, in which the co-ordinates (x, y, z) of C correspond to the proportions in which X, Y and Z must be mixed to match C. The lightness or darkness of C is specified separately by the brightness factor.

We may note the following points about Fig. 2. The spectrum locus shows the colour quality of the individual

wavelengths through the spectrum : any composite stimulus will necessarily have a colour quality lying inside the spectrum boundary and nearer the white point S. An alternative specification of C is its dominant wavelength λ and excitation purity p , where λ is the wavelength of the monochromatic light, which, when mixed with a specified white light S in suitable proportions, will match C, while p expresses the proportion in which λ has to be mixed with S, as measured by the ratio of the distance CS to λ S, that is,

$$p = \frac{CS}{\lambda S}$$

This dominant wavelength-purity specification is frequently very convenient in descriptive work, since the dominant wavelength will give an approximate idea of the hue of C, according to whether λ is in the red, yellow, green, etc. part of the spectrum, while p indicates the saturation or vividness of C ; thus, as p approaches unity, C is approaching the saturated spectral colours or purple and as it tends to zero, C is approaching white or grey.

In discussing the performance of some actual photographic process, it may be practically convenient to use a chromaticity chart in terms of the actual

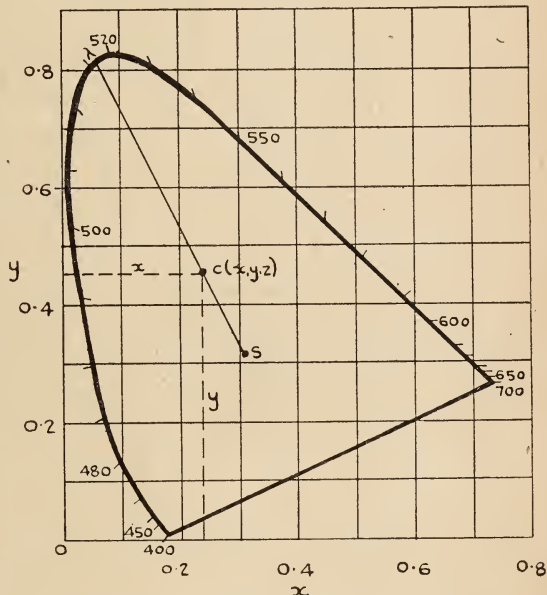


Fig. 2. The C.I.E. Chromaticity chart.

reproduction stimuli R, G, B. But where discussion between different workers and laboratories is involved, the international C.I.E. system should be used, as is done in the remainder of this paper.

2. CHARACTERISTICS OF A COLOUR REPRODUCTION.

If reproduction of a scene were perfect, then the quality of the picture in every respect—colour, brightness, form, definition, depth and so on—would be identical with that of the original. We need not be unduly disturbed that such perfection is unattainable, but once departures from true reproduction in any respect are admitted, then it no longer follows that the closest possible approach to perfect reproduction in regard to the other attributes will necessarily be the best compromise at which to aim. For example, in the absence of any true stereoscopic effect, a useful sense of depth can be created by deliberate distortion of the light and shade; again, it is quite impossible with the restricted range of brightnesses available ever to give a true objective representation of the brightness levels of all types of scene that may from time to time be portrayed. Distortion of both light and colour values may, however, lead to very effective compensation.

Thus colour is an additional variable superimposed on a reproduction which in other respects is far from perfect. In that event we have to examine the principles on which to decide the best compromise between perfection and distortion.

As a start we may confidently summarise the more important sources of error in the subtractive process.

- (a) The range of colours which can be reproduced is limited. The area of the chromaticity chart which can be covered may be as shown in Fig. 3. Here, Y, M and C represent the colours of the yellow, magenta and cyan subtractive primary dyes used in the process, while R, G and B correspond to the red, green and blue stimuli whose intensities are controlled by these dyes. We should, however, note that this range of colours will be less for the lighter colours and that R, G and B vary to some extent for different densities of the dyes.
- (b) The characteristic curve for each process may not be linear and, where linear may not have a slope of unity. Where all the gammas are greater than unity the colours tend to increase in saturation and *vice versa*. If the three processes have different gammas, greys will acquire a hue at certain lightness levels.
- (c) The spectral sensitivity curves of the negative emulsions may be incorrect generally in a sense to make the colours more saturated.
- (d) The yellow, magenta and cyan dyes have non-ideal absorption characteristics which tend to make certain colours, more especially blues and greens, too dark and which may produce some error of hue. Partial correction by masking is possible.

Conclusions Reached

To what extent is the limited range of colour a handicap? Fig. 4 shows the position on the chromaticity chart of a selection of well-known artists' pigments, from data published by N. F. Barnes¹. We may conclude from this that while some colours will be difficult to reproduce, the potential range of colours is likely to be sufficient for most normal subjects². It is interesting to note, too, that many paintings by old masters include only a very restricted range of colours, and it is worth considering that certain sequences might be admirably reproduced with quite a limited colour range. In principle, this should simplify the reproduction process by the choice of less widely spaced positions for R, G and B, which in turn should lead to smaller errors and greater refinement in the more subtle and consistent

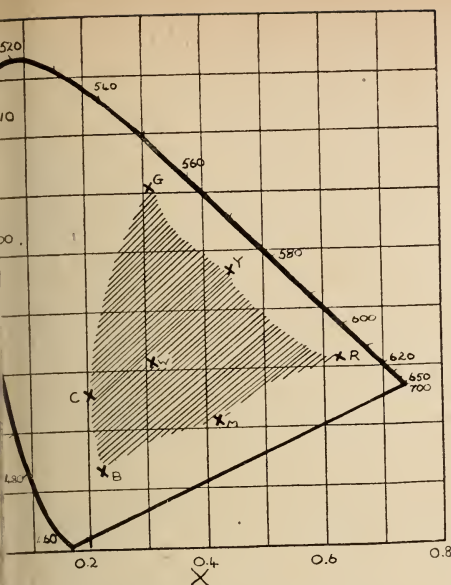


Fig. 3. Chromaticity chart showing by the shaded area typical range of colours which can be reproduced in a three-colour subtractive process of colour photography.

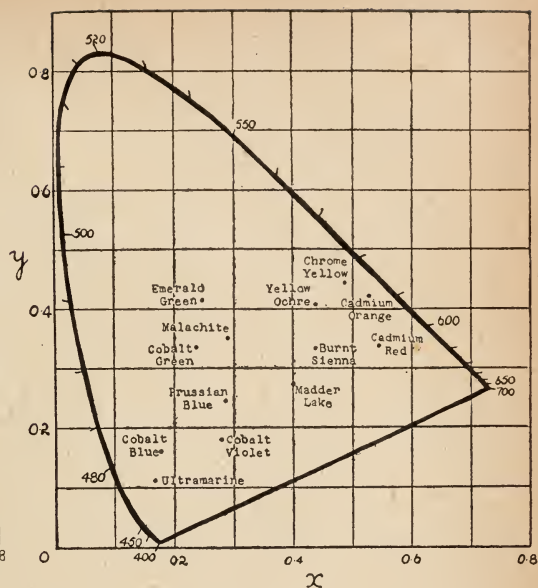


Fig. 4. Position on Chromaticity chart of well-known artists' pigments.

reproduction of fine colour differences. In practice, of course, the use of different dyes for different sequences might be an intolerable handicap.

Colour range, however, is only one aspect of a reproduction, for each type of subject has certain visual qualities which, assuming perfect reproduction is unattainable, may require a particular compromise in reproduction characteristics to achieve the most successful representation. We may best illustrate this point by three examples.

Respective Materials

In the first place, consider the reproduction of the folds of a dress as illustrated in Fig. 5 (a), when the material is either silk, velvet or wool. The colour of a material is determined partly by the spectral absorption of the light as it passes into and through the fibres of the material before being reflected, and partly by the top surface reflection which has the colour quality of the illuminant. The relative contributions of these two factors depend on the nature of the fibres and on how the surface is woven.

In the case of a silk dress, there are strongly marked highlights in which the whiteness of the illumination almost completely swamps the body colour of the silk itself. If we consider the changes in light reflection and purity along, say, the line AB in Fig. 5 (a), we shall find an effect of the type illustrated in Figs. 5 (b) and (c). There will be large and rapid changes in light reflection accompanied by very large changes in purity; there may also be minor changes in dominant wavelength, but these we can ignore in this example.

The corresponding curves for a velvet dress might be as shown in Figs. 5 (d) and (e). The difference between the highlights and the lowlights (they may not be shadows as we normally understand them) will be even more marked than for the silk and, owing to the special nature of the pile of the velvet material, the highlights will be located at different positions relative to the folds of the dress, a feature which is peculiarly characteristic of velvet. Moreover, the manner in which the light penetrates into the pile leads to

a deep, rich colour in the lowlights, which is recorded colorimetrically by the high purity, so that Fig. 5 (e) shows an even greater purity range than Fig. 5 (c).

The absence of gloss with the rougher woollen dress leads to the quite shallow types of curve of Fig. 5 (f) and (g). There will be relatively small variations in top surface reflection across the folds of the material and, since the surface reflection is at no point very intense, the body colour of the material will always be fairly well in evidence. The purity curve of Fig. 5 (g), therefore, runs at a moderately high level of purity, although never at the highest level attained by the velvet.

The curves of Fig. 5 are characteristic of these three types of material, and we can assume that, in a good reproduction, the light reflection and purity should vary relatively to one another somewhat in the manner shown. It is evident that materials such as silk and velvet are likely to present a much easier problem to the kinematographer, since the gross changes in light and purity will demand little subtlety of reproduction, and errors in the hue and saturation will be of minor significance provided the general character of the surface reflections is brought out. Moreover, when the person wearing the dress walks across the stage, the folds in the dress change their position so that the areas of high light and the areas of high purity move rapidly from point to point of the dress. These rapid movements are also easily reproduced on the screen and any lack of constancy of the processing conditions of the film is quite innocuous, relative to the genuine fluctuations that are taking place.

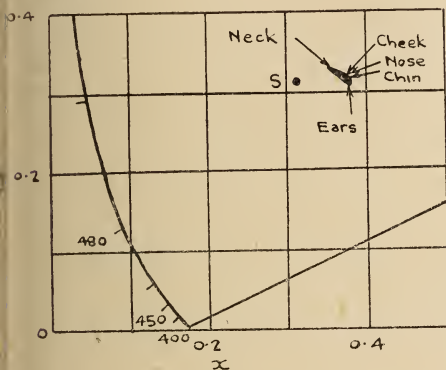
With the woollen material, the surface characteristics are less interesting and incidentally of less assistance in suggesting the third dimension, although their adequate reproduction calls for greater refinement and greater constancy of quality than in the case of silk and velvet. Also, the importance of definition becomes relatively greater in giving a good rendering of the softness of the texture, and if the fibrous nature of the surface, more especially at the edges of the material, is below the resolving power of the photographic process, then it may be desirable to introduce a pattern, such as a check or a herring-bone, which the audience would automatically associate with a tweed or serge type of material, but not with silk or velvet. Although very simple, this illustration provides a useful illustration of how the relative importance of colour, lightness and definition may vary from one type of surface to another.

A second example we can consider is that of a daffodil plant. If we examine the leaf of a daffodil we find there is a continuous variation of lightness, hue and saturation from one end to the other. It is not that the actual colour specification of any part of the leaf matters very much, but rather the simultaneous variation of the brightness factor, dominant wavelength and purity which we associate with the daffodil leaf. The colour of the leaf is also, of course, linked in our minds with the yellow daffodil flower. It may well be the case that both the brightness and the saturation characteristics could be distorted without seriously affecting the appearance of the leaf and flower, but if one were distorted and the other correct then the reproduction might be unsatisfactory. This type of problem needs quantitative investigation.

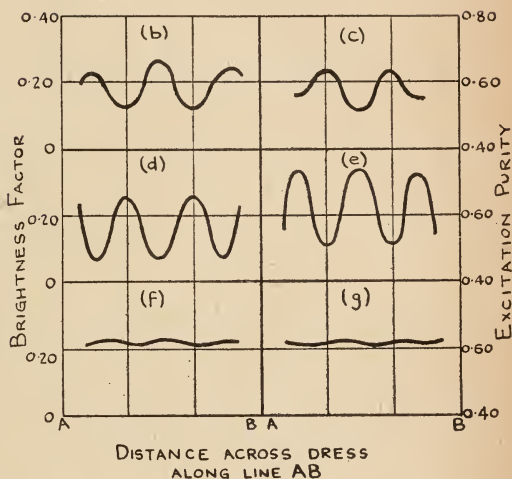
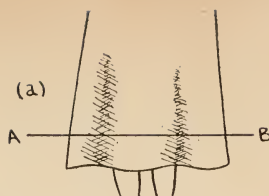
Flesh Tints

As a third type of subject, we may consider the problem of flesh tints particularly the face, which is perhaps the most important with which the photographer has to deal. While the colours of faces differ considerably from one to another, the variations in flesh tints over any given face are generally surprisingly small. Fig. 6, for example, shows the area of the

- g. 5. Variations in Light Reflection and Purity across the folds of a dress, along the line AB in (a).
 (b) and (c) Brightness Factor and Purity for Silk material.
 (d) and (e) Brightness Factor and Purity for Velvet material.
 (f) and (g) Brightness Factor and Purity for Wool material.



g. 6. Colour of different parts of a typical face plotted on the C.I.E. Chromaticity chart.



chromaticity chart within which the colour of the cheeks, chin, forehead, nose, neck and ears of a typical face will lie, if the white highlights having the colour of the illuminant are ignored. The smooth texture and delicate colouring of the cheek, for instance, are appreciated largely through very small variations in hue and saturation, while the modelling of the face as a whole depends more on variations in light and shade than on changes in colour. A coloured face is no adequate substitute for a finely modelled face, especially if the colour is not stable and if the finer variations of hue and saturation cannot be recorded. In my opinion only in the case of a negro is the rendering of a face by colour kinematography generally superior to that obtained in black-and-white films. Too often with pale faces the lightness, hue and saturation variations are smoothed out.

3. TOLERANCES

It is easy to show that the permissible errors of colour reproduction are affected by so many factors that it would be practically meaningless to lay down any tolerance values. At the same time it is not very helpful to ignore the problem, and we can at least consider some of the factors which do affect the noticeability of errors.

First, there is the familiarity with the true colour of the object being portrayed. Take the Union Jack, for example. If the hue of the red is in error by being too orange or too purple it will be objectionable; if the red is too dark or too desaturated, it will be less serious as this can correspond to a flag being dirty or faded, provided the blue and white are similarly affected. For this type of problem, the data recorded on the noticeability of colour differences across the chromaticity chart by MacAdam and by the author³ may be applied fairly directly so far as the relative noticeability of errors in different parts of the chart is concerned. However, we may note that the sensitivity to colour differences is greatest when two large areas of colour are being simultaneously compared, with a sharp dividing line between them.

If the areas are small and are widely separated either in space or time, then larger differences will pass unnoticed.

In most problems, though, we are less concerned with the accuracy of two or three clearly defined colours as in a flag, than with the realism of an object perceived as an entity although built up from a varying pattern of light, hue and saturation. In the case of the daffodil, previously discussed, it may not be important if the hue of both leaf and flower are in error, provided they are in error in the same direction; or an error of saturation of the greenest part of the leaf may not matter if the whole of the leaf is affected by an error of the same type. To specify tolerances in such a case from laboratory data on discrimination is manifestly impossible; instead, the effect of different errors on the reproduction of the whole object must be studied as a problem on its own. Obviously, this could lead to a vast programme of work, but it could no doubt be kept within reasonable limits if carried out systematically on an appropriate selection of objects.

With some types of object, it might be quite acceptable to use a process which yielded relatively large errors in the average colour, provided the fine variations of colour over the surface of the object were successfully reproduced. This would apply particularly to the reproduction of the texture of matt surfaces; in the case of the texture of skin, for instance, the chromaticity variations over the cheek may not amount to more than 0.005 or 0.01 of x or y in the C.I.E. These differences set an exacting target in the discriminating power and constancy of the photographic process.

4. ADAPTATION CONDITIONS

In addition to the local contrasts which exist between neighbouring areas of a scene or picture, and which have a most important effect on the appearance of each area, the general state of adaptation of the eye can affect the brightness, saturation and hue of the colours in the scene. Owing primarily to the photo-chemical reactions which take place in the retina when stimulated by light, the sensitivity of the eye is continually being adjusted to suit the prevailing quality and intensity of the illumination. At high illuminations the eye becomes light-adapted and has a low sensitivity; at very low illuminations the eye is dark-adapted and has a very high sensitivity; if the illumination is reddish, the sensitivity to red light is diminished, and so on.

In the cinema, the audience is in a partially dark-adapted state and sees an illuminated screen against a fairly dark surround. This is almost always a very different state of adaptation from that in which the audience would have been if it had been at the actual location of the scene being portrayed.

Apart from questions of visual discomfort which may be felt when looking at an illuminated area in a dark surround, the existence of the dark surround might be regarded as advantageous when brightly illuminated scenes are being portrayed, since the limited amount of light available on the screen will have an enhanced apparent brightness due to the contrast with the black surround. On the other hand, for the correct portrayal of darker scenes, an illuminated surround would provide the appropriate contrast to create an effect of greyness and blackness on the screen without the need to lower the illumination on the screen itself to such an extent that the picture would be unduly flattened by the stray light in the auditorium.

Colour Adaptation

So far as colour adaptation is concerned, there is room for a good deal more experimental work. In investigations carried out by the author on the effects of adaptation on the apparent colour of a test object by a binocular matching method,⁴ the test object was viewed by the right eye and matched

against a comparison patch viewed in the dark-adapted left eye. The right eye was then subjected to various adaptations of different colour and intensity, and a new match made between test and comparison patches. The change in the match was then a measure of the change in sensitivity of the eye produced by the adaptation.

These researches were carried out primarily for their interest in the physiological working of the retina, but R. M. Evans⁵ has applied them to problems of colour reproduction and drawn a number of tentative conclusions of some interest. In some respects the adaptability of the eye is helpful in the sense that any general error of colouring of a scene will be partially compensated by an adjustment in the sensitivity of the eye. If full advantage is to be taken of this compensation, however, it is necessary that there should be no external clues by which to judge the quality of reproduction, *e.g.*, no illuminated white surfaces visible to compare with the whites in the picture. This point would have to be borne in mind in the use of an illuminated surround.

Another important conclusion reached by Evans is that the colours in a picture should be consistent internally; that is to say, the lightness and saturation of the colours should be correctly related to the subject, and the rendering of some colours should not be better than others. Another point he makes is that the larger the picture, the more brilliant will the colours appear, and since desaturation and degradation is the general tendency produced by some of the reproduction errors, this is a factor of considerable interest and significance. Further experimental work on these lines is required, but it is satisfactory that visual data are becoming available from which an analysis of phenomena familiar enough to artists, can be attempted in scientific terms.

Changing Colour of Scenes

A feature in the kinema which could be disturbing is the sudden change from one scene to another every few seconds. This could have disastrous effects on colour rendering if the eye, after having become adapted to a scene in which one hue predominated, were presented with another scene of a very different hue. Binocular matching experiments show that the eye may require about a minute to become approximately adapted to a particular quality and intensity of light and about three minutes to recover from the main effects of the adaptation. Normally in the kinema, a given scene is only viewed for a few seconds, and for this short duration of exposure the eye becomes only partially adapted, recovery follows within a few seconds of the removal of the adapting light. Most of the possibly unfortunate effects of this adaptation process are largely unnoticed in the kinema owing to the variegated pattern of colour of which the majority of scenes are composed; this has a double effect, since there is less likelihood of any given area of the retina becoming strongly adapted to a particular colour, while if such local adaptation were to occur, its effects would tend to be swamped by the pattern of colour of the succeeding picture.

We can conclude that any effect which is produced will be most noticeable when the preceding scene is highly coloured and having one hue predominant, and the following scene is fairly uniform and not very highly coloured. Binocular matching experiments have shown further, that the most specific adaptation is produced by red light, so that it must be anticipated that red scenes are likely to be most disturbing on subsequent scenes.

We should realise that the change of colour with time provides the kinema with an additional dimension which has not been at the disposal of the artist, and there may be some novel methods of handling this transition from one coloured scene to another which have yet to be explored. It is to be hoped

that scientific information about the underlying visual phenomena may help to speed up the assimilation of the possibilities by the kinematic artist.

5. ANALYSIS OF ÆSTHETIC CHARACTERISTICS

In Section 2 it was tacitly assumed that the aim of a colour photograph was to reproduce as closely as possible the visual appearance of the subject being photographed. It was recognised that this might not demand exact objective reproduction of the colours in the original owing to extraneous factors of adaptation, etc., by which the sensitivity of the eye might be altered; deliberate distortion of the colour rendering was therefore envisaged to compensate for this modified sensitivity and to provide a closer approach to an apparently perfect representation.

In a work of art, however, naturalistic representation may not figure at all prominently in the mind of the artist; on the contrary, the ideas he wishes to express may require deliberate and conscious distortions of the light and colour relations in a manner which may become characteristic of the artist rather than of a particular type of picture.

Of course, much of the artist's technique cannot easily be described in colorimetric terms. For example, the extent to which the pigments are mixed either subtractively on the palette or additively by suitable handling of the brush, so that different streaks of pigment lie side by side on the canvas, will not only determine the colour range that can be obtained with a given set of pigments, but will also greatly affect the texture of the painting. The artist attaches great importance to texture, and it is obvious that he has a freedom to control the colour and texture of his painting that is denied to the photographer.

Nevertheless, unless a picture is pure anarchy, a broad relationship must exist between the colours of a painting which it should at least be possible to describe in general, and possibly in fairly specific terms. Such relationships seem to be acknowledged by artists as a necessary feature of a painting if any degree of unity and suavity is to be achieved, and although it is doubtful whether they have ever been described on the trichromatic system, we should note that writers such as Pope⁶ have attempted an analysis in terms of a colour solid built up of pigmented patterns.

The analysis may be carried to various degrees of refinement and in the elementary stage, a picture may be characterised by:

- (1) Its lightness or darkness,
- (2) Its hue range,
- (3) Its saturation level.

This is so obvious that it need not be elaborated here except to emphasise once again how many pictures have a relatively limited hue range.

We can see already, however, that by combining (1), (2), and (3) in various ways, a great variety of effects becomes possible. This is especially true if it is regarded as legitimate for the lightness and saturation relations to vary from one hue to another.

If the analysis is pressed further, we can see that the saturation distortion between original and reproduction may not be linear. We are familiar with the characteristic curve of a black-and-white photographic process in which the logarithm of the exposure is plotted against the density of the developed emulsion. Only part of this curve is linear, and the accuracy of light and shade reproduction depends on the extent to which the exposures of the different parts of the scene occur within the linear portion of the curve, and also on the slope of this linear part.

In the same way, some similar relationship can be visualised for the saturation reproduction, which in colorimetric terms might be expressed by a

"purity characteristic curve" and a "purity gamma." For each hue some such curve as Fig. 7 must exist in a photographic process by which the distortions in purity can be judged. The amount of published photographic data is too meagre to judge whether or not this curve is likely in general to be linear, while in the case of the artist's painting it is doubtful whether any quantitative data is available at all.

Nevertheless, the existence of such relations is recognised, as Pope has described and in terms of which he has to some extent classified the works of

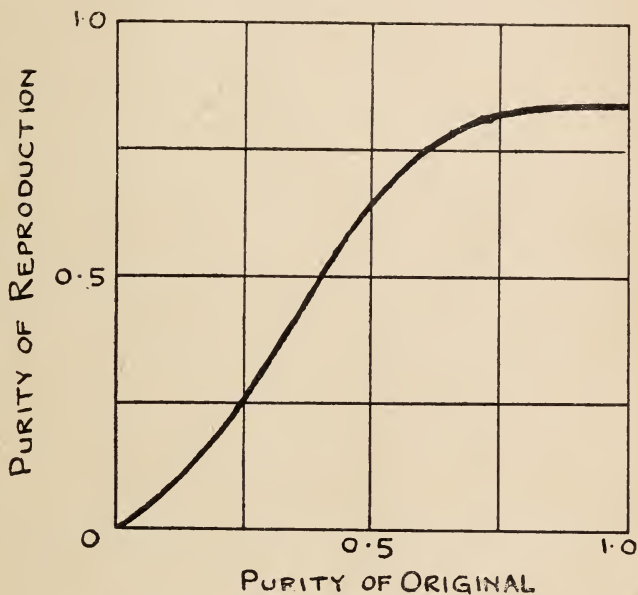


Fig. 7. Possible "Purity Characteristic Curve" for a Colour Reproduction Process.

different painters. An extraordinarily complex situation can arise if the likelihood of the purity gammas being different for different hues is acknowledged, and if there are hue distortions as well. No doubt a hue gamma could be envisaged, and although at this stage such a conception may not be very helpful, we can see that it is this possibility of infinite variety which gives the artist his freedom without anarchy, and which photographers may envy.

6. CONCLUSION

Ultimately, we may hope that the photographer will have at his disposal a wide range of photographic emulsions and processing conditions giving different brightness and purity characteristics and with which he may endeavour to emulate the artist more nearly than at present. This, however, is a long-term prospect; the more immediate problem is to know how to put the materials which are now available to their best possible use. Experience with the process is obviously an essential, but with so many variables to affect the quality of the picture, it can never be easy either to decide just what makes one shot so good and another so bad, or to design a set in advance and be certain of producing the effect in the mind of the designer. In any case, with two-colour processes coming into use again, a study of the colorimetric characteristics of the process and their correlation with the visual qualities of the reproduction, may lead to more perfect results in a shorter period.

To conclude on not too vague a note, I would submit the following list

of features as among the more important colour attributes which should be observed in a film in an attempt to assess its merits :

- (1) General lightness values in relation to subject matter.
- (2) General saturation values in relation to lightness.
- (3) Lightness gradations.
- (4) Saturation gradations.
- (5) Overall range of hues.
- (6) Hue gradations.
- (7) Lightness and saturation of different hues.
- (8) Errors of hue.
- (9) Rendering of small differences of hue and saturation in highlights.
- (10) Stability of hue, saturation and lightness with time.

If these attributes can be correlated with colorimetric data supplied by the photographic manufacturer—brightness characteristic curve, purity characteristic curves for different hues, hue range at different brightness levels, hue and purity discrimination limits and so on—it should become easier to decide what types of scene can best be handled by the process being used and what different characteristics are required for improved rendering of other scenes.

It is possible to visualise a systematic programme of research in which deliberate distortions of the various characteristics are introduced in an attempt to find the optimum combination for each type of scene. Unfortunately, the carrying out of such a programme postulates the easy control of emulsion types and processing conditions, and colour chemists may well have doubts about its practicability. Perhaps with the perfection of colour television we may be provided with a tool more readily adaptable to such a research programme.

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DISCUSSION

MR. H. WALDEN : What is purity? It is not saturation, is it?

THE AUTHOR : Purity is the objective correlative of saturation; saturation is the subjective estimation of the increase in colourfulness—purity is one way (there are other ways) of measuring that objectively. The amount of a spectrum colour which has to be mixed with white to match a colour is a measure of its purity.

MR. RUDD : I am a little confused about the tie-up between hue and lightness.

THE AUTHOR : Lightness is governed by the amount of light reflected from a surface. Colours may be of the same lightness, but differ in hue. Two colours can be recorded by the same point on the chromaticity chart, but one can be light and the other dark.

MR. W. BUCKSTONE : Can Dr. Wright give us some idea of the time involved in getting the eye adapted to a colour, and also the recovery time?

THE AUTHOR : It is not easy to measure these adaptation effects. Quite a lot of work was done during the war on dark adaptation, but less on colour adaptation. One method I have used quite extensively is a method of binocular matching, in which you view a test colour with the right eye, and a comparison colour with the left eye. You then subject your right eye to varying degrees of adaptation, either of light or colour, and on removing the adapting light, you re-compare the test and comparison colours. By measuring the change produced by the adaptation you can determine by how much the sensitivity has changed, and you can plot the course of light adaptation and recovery. To become adapted to a particular light takes something about one or two minutes, although even after the three minutes are up there may still be some degree of adaptation going on. Within about two minutes after the adapting light has

been removed most of the loss in sensitivity has been recovered.

MR. GREEN: You mentioned that it might be a good idea to have a lighter band round the edge of the screen, when you had a dark scene. Could you expound that?

THE AUTHOR: If you want to portray a bright scene, a dark surround, by contrast, throws it up. If you want to show a darkened scene, then if you make your film too dense the light from the auditorium tends to de-saturate the less intense colours, and you get a loss of contrast, without getting the sense of darkness that you want. If you had an illuminated surround it would be easier to get, by contrast with the illuminated surround, the appearance of darkness, without having to reduce the amount of light so much on the screen, and get de-saturation from the auditorium.

A VISITOR: Presumably you can plot on the chromaticity diagram colour temperature as a range of degrees, until finally it will pass through to equivalent daylight. Is that the same as the white on the chromaticity diagram, about $5,000^{\circ}\text{K}$?

THE AUTHOR: The locus of illuminants of different colour temperatures can be plotted on the chromaticity diagram; it passes from orange through white, to blue-white.

MR. R. H. CRICKS: We have seen a number of two-colour films, and the average layman cannot tell the difference from three-colour. Would Dr. Wright care to comment on that?

THE AUTHOR: Properly exploited I would say that some two-colour processes might produce highly satisfactory results.

MR. R. H. CRICKS: Green is of course the biggest problem, as confirmed by Fig. 3.

MR. HARTE: Could Dr. Wright give some indication of the cut-off of the three components of the retina of the eye? Are they square in form?

THE AUTHOR: We do not know with certainty, but on the orthodox trichromatic theory, the sensitivity curves of the three types of receptor are quite broad. They are not square-topped, like transmission curves of an ideal filter. The maximum red sensitivity is probably at $.58\mu$, and comes to zero about $.47\mu$. The green has a maximum at $.54\mu$ and comes down so that at $.65\mu$ it is pretty nearly zero, and at the other end it drops fairly rapidly down to $.48\mu$, then continues at a low value right to the end of the spectrum. The blue has its maximum at $.46\mu$, and is the narrowest of the three, approaching zero at $.53\mu$. If the colours did not overlap, we might see black bands in the spectrum.

POLYTECHNIC KINEMATOGRAPHY COURSE DISCONTINUED

The Governors of the Polytechnic announce with much regret that the two-year course in cinematography, organised in conjunction with the Society, is to be discontinued. This implies that no students will be enrolled this year, although the twelve students—all ex-service men—now entering upon their second year will, of course, complete their period of tuition.

The course was inaugurated in 1932, on the proposal of the then B.K.S. President, Mr. Simon Rowson. Among its former students are to be found technicians and executives in all branches of the film industry, and in the related research laboratories. Ten students have successfully completed the course this month.

The reason for the cessation of the course is the decision by the Film Industry Training and Apprenticeship Council that the course does not fit into the framework of the training proposed for newcomers into the Industry.

The three courses of evening lectures which have for a number of years formed part of the Polytechnic programme will continue, as follows:

Sensitometry and Laboratory Practice (commencing September next).

Sound-film Recording and Reproduction (commencing January, 1949).

Photographic Optics for the Film Industry (commencing April, 1949).

The lecturer is Malcolm V. Hoare, B.Sc., M.B.K.S., who is however no longer a full-time member of the Polytechnic staff.

The Education Committee of the Society, under the chairmanship of Mr. A. G. D. West, M.A., B.Sc., Hon.F.B.K.S., has for some time past been considering the extension of the Society's educational activities, and it is hoped shortly to make an announcement concerning additional educational courses open to technicians in various sections of the Industry.

BRITISH FILM ACADEMY

The British Film Academy hope, during next winter, to organise a series of regular meetings in London at which British and foreign film-makers will speak on various aspects of the art of the film.

The Academy has extended an invitation to all members of the B.K.S. to attend these meetings, the dates of which will be announced later.

THE FILM IN COLONIAL DEVELOPMENT

*Summary of papers read to the B.K.S. Sub-Standard Film Division on
November 26th, 1947.*

I. INTRODUCTION

George Pearson, Hon. F.R.P.S.*

IN the production of films for the illiterate native population of Africa—a work to which Mr. Sellers has devoted half a life-time—we are faced with limitations and restrictions unknown to the worker in free kinema. We have to achieve, despite enforced restrictions, exactly the same results desired by the commercial film makers in relation to their audiences: clear understanding and complete appreciation, but in our case, by an audience, unable to write, unable to read, primitive in customs. This formidable task has been surmounted by the Colonial Film Unit, a non-profit-making body formed under the auspices of the Central Office of Information.

My contribution to the Colonial Film Unit has been mainly concerned with the development of a type of production fitted to the mentality of the Colonial people. There is one generalisation I dislike—that our work needs only inferior technical skill, and, in fact, is likened to making films for little children. Our task calls for technical skill of the highest order.

The Basis of Education

These films must be fashioned on the basic principles of all education, in that they must obey the laws of all human mental progression. They should, therefore, affect the viewer in the following ways: first, sensation—all knowledge derives from sensation; secondly, perception—every sensation stores a fresh percept in the mind; thirdly, conception—comparing our percept-memories conjures up fresh ideas; lastly, thought—conception ultimately leads to thought. That briefly is educational progress.

The only way to obtain these reactions is to interest the audience by showing films about themselves. This has been attempted by sending film units to Africa, to make films on African soil, with African surroundings, peoples and customs. This has been found to be the only way to catch the Colonial peoples' interest swiftly, and to hold it firmly. No camera tricks or strange angles must confuse him, or anything that might jerk his mind from the story. This would cause loss of mental thought continuity.

It is the aim of the Colonial Film Unit to give the African native that outlook and vision which will urge him to break the bonds of illiteracy. In this way he can become a good citizen, which will eventually lead to the final goal of self-government.

II. COLONIAL FILM UNIT.

W. Sellers, M.B.E.*

IT is just over six years since I addressed the B.K.S.† on the subject of film production for the primitive people of the Colonial Empire. Our films, regarded by Western standards, might be described as very dull. In Africa, however, they are enormously successful, as, for example, *Mr. English at Home*, a film dealing with the everyday happenings in Britain. This film deals with the daily life of an average English family, telling the story in a way the Africans can understand. This is still the most popular film, although it is seven years since it was completed.

*Colonial Film Unit

† *J. Brit. Kine. Soc.*, July/Sept., 1941, p.104.



Stills from "Good Business"

When the Colonial Film Unit was formed in 1939 its primary task was to attempt to interpret the war to Colonial people, who were to contribute substantially to the war effort. Films showing Colonial troops at the front, and showing food and war production which utilised Colonial raw materials, such as vegetable oil and timber, were immensely popular.

The Raw Stock Scheme.

With all these war films the value of the familiar scene in film education was not overlooked. A bold scheme was formulated in 1941, known as the Raw Stock Scheme. Specially chosen people, chiefly Colonial officers connected with information or education, were provided with 16 mm. cameras and equipment, and were encouraged to record local events, and subjects of social and economic importance. The material shot was sent to Britain, where processing, titling and editing took place, and was then returned to the Colonial territories with a detailed constructive criticism.

Journals containing articles on 16 mm. motion picture equipment were distributed by members of the Colonial Film Unit, to assist those participating in the Raw Stock Scheme. These articles were a virtual correspondence course for the sub-standard director and cameraman. Instructional courses were held in London for the Colonial officers home on leave. This scheme has been continued since the war, and is proving very successful. Some films produced by the officers have proved to be of more than local interest.

Peace-time Progress

By the end of the war the output of the Colonial Film Unit, quite apart from the 16 mm. scheme, had reached 230 films. A new phase in the Unit's history began in 1946, when the first overseas production unit went to the Gold Coast. This was the start of the long-term programme. Seeds of progress in health, industry and agriculture were sown by this form of mass education, the breaking of tradition-bound ground. Two more units left for Africa in the autumn of 1946. The films shot included a record of the opening of the first Nigerian Legislative Council under the new Constitution.

The problem of distribution meant that 76 16 mm. release prints of each film were produced, and upwards of 40 million people saw each film made. Many colonies have now appointed their own film officers. They are responsible for the organisation of the work of the kinema vans and their maintenance and servicing staff, for training personnel, and many other duties.

It is apparent that our present Government has a declared policy to train Colonial people as film technicians. This policy has been well to the fore in the plans of the four production units which have recently travelled to Africa. At least twenty units can be accommodated in the Colonies. A seven-year training plan is now in operation to obtain this strength. The first



Stills from "Good Business"

regional film school will be opened in August in Accra, capital of the Gold Coast. Those selected for training are well educated Africans, with a distinct flair for film production.

The full co-operation of the Colonial people will be needed to bring all these hopes and aspirations into reality.

During Mr. Seller's paper the films "Good Business," and "A Kenya Village Builds a Dam," were projected.

DISCUSSION

Mr. H. S. HIND : Have you any indication as to whether illiterate Africans prefer colour to black-and-white, and if colour films have any added advantage? Have you tried animation of films?

Mr. SELLERS : There is no doubt that colour does help. In our raw-stock scheme we are liberal with the stock—it is the cheapest part of film making—and we have issued Kodachrome to those territories where we know it is going to be used to good advantage. Some day I am sure that all our work will be in colour.

As far as animation is concerned, we have at the moment two cartoon films in production. Because they are being specially made I believe they will be successful with the natives.

Mr. H. C. SNOWDEN : Is the Colonial Office doing anything towards making entertainment films, as distinct from purely educational and propaganda films?

Mr. SELLERS : We have constant demands for entertainment films, but it is most difficult to find the right kind of entertainment film. The things that amuse Africans are not always the same as those that amuse us. We have made one or two comedies of subjects they know something

about. If films have a story value of such interest to our audiences, they do not want anything more at the present time.

Mr. PEARSON : Our entertainment really consists in tying our information to African characters, that is good entertainment for them.

Mr. R. H. CRICKS : I recall that when Mr. Sellers previously spoke to the Society, he emphasised the slower tempo needed in his films. The films we have seen to-night did not seem so slow in tempo.

Mr. SELLERS : There is a noticeable difference. It takes more time for Africans to understand unfamiliar surroundings, but when they see something that is familiar, they are quicker to take in the picture and what it means. I realised when we were projecting the film "Good Business" we had several mixes—about the first time we have used them—previously audiences had misunderstood them.

Mr. D. CANTLAY : I would like to ask Mr. Sellers about print quality. Do you usually make reduction prints from 35 mm.?

Mr. SELLERS : Yes; our problem is to get good prints by optical reduction. Our work is judged in the Colonies by the quality of our 16 mm. prints.

INTERNATIONAL SCIENTIFIC FILM CONGRESS

The second congress of the International Scientific Film Association will be held in London from October 4th to October 11th, 1948.

The Association was constituted last

year in Paris by delegates from 22 countries, who had accepted the joint invitation to the inaugural congress from the Scientific Film Associations of Great Britain and France.

FROM SILENT TO SOUND

B. G. Anstruther, M.B.K.S.*

Summary of paper read to the B.K.S. Theatre Division on January 25, 1948.

TRACING the progress made in cinematography since the days when Thomas Edison first conceived the possibility of "a machine to do for the eye what the phonograph does for the ear," Mr. Anstruther referred to the advances in the thermionic valve, made during the 1914/8 war, which made it possible to cut discs of high quality, and to amplify the resultant sound to fill a large auditorium.

In order to prolong the running time, a disc was recorded and reproduced at a speed of $33\frac{1}{3}$ revolutions per minute. With a diameter of 16ins. or 18ins., such a record would run for about nine minutes.

In view of the objections to sound-on-disc—the risk of loss of synchronism, the fact that if a film broke, the exact length had to be maintained by the insertion of spacing—it rapidly became evident that although the quality of sound-on-disc was generally superior to that of sound-on-film, the former would have to give way to the latter.

The Invention of Film Recording

As early as 1906, Eugene Lauste had produced a sound track on film. In the early 1920's, such systems of recording had formed the subject of articles in the *Wireless World*. In 1926, demonstrations had been given in London by De Forest Phonofilms, but, due to the quality of sound, they had caused no perturbation to the exhibitor.

Mr. Anstruther described briefly the Western Electric, Klangfilm, and British Acoustic systems of recording, recalling that the last had originally employed two separate films for picture and sound. He explained the reason why film speed had been increased to 24 frames per second.

In 1929, full-length talking films had begun to make their appearance, and the silent picture was doomed. The first kinema installations were of foreign origin, but the urgent need for sound apparatus attracted many and various adaptations to silent projection equipment. Some of these allowed the reproduction of sound-on-disc only; others had various types of sound heads, operating with poorly designed amplifiers. The loud-speaker systems embodied long horns, curved horns, flat baffles and cabinets.

Converting the Silent Kinema to Sound

The silent kinema, continued the speaker, was generally a rectangular building, with a screen usually of white-washed plaster, surrounded by an imitation proscenium arch. The projection equipment was often housed in a small booth, sometimes badly ventilated, and presenting very uncomfortable conditions in which to work. The projectors consisted of lightly running front-shutter machines, usually belt-driven by 80-110-volt D.C. motors, the speed controls of which were sliding rheostats.

The conversion of such equipment to sound had involved the following requirements.:

1. A projector capable of steadily projecting 24 frames per second.
2. A constant-speed motor capable of driving it.
3. A lamp to illuminate the picture.
4. A sound-head with provision for drawing the film uniformly past the optical system.
5. An amplifier capable of amplifying the small output from the photo-cell to a sufficient power to operate the loud-speakers situated at the screen end of the auditorium.
6. A device for changing over the sound-head connections as the picture projection was changed over,

*Odeon Theatres, Ltd.

Frequently the exhibitor found that new projectors were required. The fact that many programmes included both sound-on-disc and sound-on-film subjects necessitated the provision of an adjustable mask in the projector gate to cover the sound track.

Increased Illumination

Improvements in the photographic quality of films, and the introduction of colour, led to the development of more powerful arc lamps. The consequent increase in the amount of heat concentrated on the projector gate led in turn to the placing of the projector shutter between the illuminant and the gate—a design which might, said the speaker, become compulsory in all British cinemas under the proposed new Home Office regulations.

The introduction of more powerful arc lamps, needing higher currents, also led to the popularisation of various types of static rectifiers. The advantages of this type of conversion over the motor-generator were its greater efficiency, its silence, and the fact that it could in some cases be housed on the projection box level. In addition, the output voltage of the rectifier was often less, and the amount of energy wasted in ballast resistances was reduced.

Acoustic Developments

It was found that the illusion of sound-film presentation was greatly enhanced if the loud-speakers could be placed near the centre of the picture, and the sound projected through the screen. The arrangements whereby the speakers were mounted either side of a plaster screen were superseded on the introduction of the acoustic screen. Early types were woven, but the perforated matt screen was now the more popular type.

The speaker next turned to the subject of acoustics, commenting that the worst difficulty of the early sound engineer was to convince the exhibitor of the value of sound treatment. Acoustic improvement was effected by trial-and-error, both in the auditorium and in the speaker horn or baffle.

Mr. Anstruther concluded his paper by referring to the recent improvements in extending the frequency range. The reproduction of higher frequencies had demonstrated that the film was being subjected to variation in traction, due either to mechanical vibration from gearing, or adhesion of the film in the sound gate. A progressive move by the manufacturers resulted in the general adoption of the drum or roller type of sound-head.

The reproduction of these higher frequencies owed much to those who had brought the science of acoustics to a stage where it was possible to predict, while a theatre was still on the drawing-board, the reverberation period and acoustic characteristics.

DISCUSSION

A VISITOR : The reproduction from discs in the early days was quite good ?

THE AUTHOR : Yes ; it was ahead of film recording in the early days.

MR. S. C. WILLIAMS : It would be interesting to hear some of the old discs over a modern amplifier.

MR. S. B. SWINGLER : I was particularly interested in one of the theatres of which Mr. Anstruther illustrated the projection room ; this theatre had a barrel ceiling which focused the whole of the sound into the centre of the auditorium. It was not

until a scaffolding was erected below the ceiling that the effect on sound was appreciated.

In the early B.T.P. sets they had a small mechanical slit, which with the exciter lamp was mounted between the top spool box and the top sprocket.

MR. R. H. CRICKS : It was demonstrated at the Wembley Exhibition in 1925.

Two of the worst of the acoustic difficulties of the early days were back-stage reflection, and sound foci from curved walls and domes.

PROVINCIAL SECTIONS

A very successful year has been reported by both the Manchester and Newcastle-on-Tyne sections. Meetings were held at frequent intervals, and were, for the most part, very well attended.

The Council decided at its May meeting that a Section should be formed in Leeds forthwith. Discussions are in hand for the formation of a Glasgow Section.

MANCHESTER SECTION

A SERIES of eight monthly meetings were held at the theatre of the Manchester Geographical Society. The secretary is Mr. A. Wigley.

The Manufacture of Motion Picture Film

At the first meeting, held on October 7th, Mr. Grimshaw delivered a paper by Mr. A. E. Amor, F.R.P.S., on the manufacture of motion picture film¹. The paper covered the manufacture of the base, the preparation and coating of emulsion, and concluded by a review of the numerous types of film marketed.

Arc Lamp Conversion Equipment

On November 4th Mr. J. C. Milne read a paper on arc lamp conversion equipment.² A discussion ensued.

Electronics in Industry

An interesting discussion followed the paper by Mr. J. Baggs, A.I.E.E., M.S.I.T., on the uses of electronics in industry, at the meeting held on December 2nd. The paper will be summarised in a later issue.

Light and Colour in Stage Presentation

An informative paper on colour in stage presentation was read by Mr. P. Corry to the sectional meeting on January 6th. This paper also will be summarised in a later issue.

Optical Equipment for Projection

Mr. A. H. Antis presented his paper on optical equipment for projection³ at the meeting held on February 3rd. A discussion followed.

Light Projection from the Carbon Arc

An interesting paper by Mr. H. P. Woods formed the subject of the March 2nd meeting of the Manchester Section. Entitled "Light Production from the Carbon Arc," it will be reported in a later issue.

Projection Equipment

This paper, by Mr. R. Robertson, B.Sc., M.I.Mech.E., M.B.K.S., which had previously been read to the B.K.S. Theatre Division,⁴ was read on April 6th.

Planning the Projection Room

Major C. H. Bell, O.B.E., M.B.K.S., repeated, in amplified form, his paper on the design of the projection room, previously read to the Theatre Division in London. An interesting discussion followed. The paper is to be reported in a later issue.

REFERENCES

1. *J. Brit. Kine. Soc.*, Vol. 1, No. 3, Oct., 1938, p. 188.
2. *Brit. Kine.*, Vol. 11, No. 2, Aug., 1947, p. 49.
3. *Brit. Kine.*, Vol. 12, No. 3, March, 1948, p. 86.
4. *Brit. Kine.*, Vol. 12, No. 1, Jan., 1948, p. 13.

NEWCASTLE-ON-TYNE SECTION

The chairman of the Newcastle-on-Tyne Section is Mr. E. R. Eadie, and the secretary is Mr. E. Turner. Nine papers were read, and there was also a discussion meeting. Earlier meetings were held in the Neville Hall, Neville Street, but in May the venue was changed to the New Theatre, Pilgrim Street.

Some Special Purpose Arcs

Mr. C. G. Heys Hallett, M.A., M.B.K.S., A.I.P.E., read his paper on high efficiency arcs¹ at the first meeting, held on the 7th October.

A Treatise on Kinema Arc Lamp Reflectors

An interesting paper on arc lamp reflectors, by Mr. A. Brown, A.R.P.S., M.B.K.S., was read on November 4th. The paper is to be reported in a later issue.

Arc Lamp Conversion Equipment

Mr. J. C. Milne's paper presented on December 2nd² was followed by a discussion.

The Cathode Ray Tube

On January 6th Mr. G. Parr gave his paper on the cathode ray tube.³ A discussion ensued.

The Film in Relation to Television

Mr. Marcus Cooper read his paper on the film in relation to television,⁴ The paper had previously been read to a joint meeting of the B.K.S. and the Television Society.

Optical Equipment for Projection

An interesting discussion followed the reading of Mr. Howard Antis's paper on March 2nd.⁵

Kinema Engineering Efficiency

On April 6th Mr. H. E. Whitney, A.M.I.E.E., A.M.I.H.V.E., M.B.K.S., delivered his paper on the electrical engineering aspects of the kinema.⁶ A particularly interesting section dealt with fluorescent lighting. The meeting was followed by a lively discussion.

Projection Equipment

The meeting on May 4th consisted of a paper dealing with projection equipment, read by the author, Mr. R. Robertson, B.Sc., M.I.Mech.E., M.B.K.S.⁷

Planning the Projection Room

Mr. C. H. Bell, O.B.E., M.B.K.S., had as his subject the planning of the projection room. A discussion followed this interesting paper, which will be reported in a later issue of *British Kinematography*.

REFERENCES

1. *Brit. Kine.*, Vol. 11, No. 6, Dec., 1947, p. 188.
2. *Brit. Kine.*, Vol. 11, No. 2, Aug., 1947, p. 49.
3. *Proc. B.K.S. Theatre Division*, 1945/46, p. 17.
4. *Brit. Kine.*, Vol. 11, No. 6, Dec., 1947, p. 177.
5. *Brit. Kine.*, Vol. 12, No. 3, March, 1948, p. 86.
6. *Proc. B.K.S. Theatre Division*, 1944/45, p. 19.
7. *Brit. Kine.*, Vol. 12, No. 1, Jan., 1948, p. 13.

B.S.I. KINEMATOGRAPH INDUSTRY STANDARDS COMMITTEE

A meeting of the B.S.I. Kinematograph Industry Standards Committee took place on July 25th, 1948, under the chairmanship of Mr. J. Arthur Rank.

The Committee approved for publication the British Standard for 2,000 ft. 35 mm. release prints, and a British Standard for test films for 16 mm. sound projectors.

The Committee also decided to adopt B.S. 1384, diffuse transmission density, for the purpose of specifying transmission density of motion picture films.

Unified Screw Thread

A discussion took place on a proposal that the Unified Screw Thread Form should be adopted for eventual use in kinematograph apparatus. It was reported that this Thread Form had been developed following conferences with countries of the British Commonwealth and with America, and that it provided a thread form which so closely approximated to the present American National form and the Metric form that products made to the Unified Thread form would interchange with products made to the other Thread Forms.

The Committee decided to issue a directive to its Technical Committees to specify the Unified Screw Thread Form wherever appropriate in preparing British Standards.

Work of Technical Committees

The Committee received reports on the following work in hand by its Technical Committees:

CME/2.—*Motion picture films* (Chairman, Mr. I. D. Wratten). Revision of B.S. 677, Motion picture films.

CME/3.—*Standard release print reels* (Chairman, Lt.-Col. G. Symonds). Transit cases and projection spools for 2,000 ft. 35 mm. release prints.

CME/4.—*Kinematograph electrical equipment* (Chairman, Mr. L. Knopp). Kinema studio lighting, lamps and fittings; Carbon-arc equipment for studios; Ripple content in supply to studio equipment; Rating of rectifiers for kinemas; Auditorium and safety lighting for kinemas, "Exit" and "No exit" signs; Theatrical colour filters; Three-pin connectors for stage use; Electric motors for projectors; Transformers and chokes for kinematograph equipment.

CME/5.—*Projector equipment* (Chairman, Mr. J. H. Riley). Rewinding apparatus; Splicing machines; Film-storage cabinets.

CME/7.—*Terms used in the kinematograph industry* (Chairman, Dr. G. B. Harrison). Glossary of terms used in kinematography.

CME/10.—*Electro-magnetic Sound Recording and Reproduction* (Chairman, Mr. M. J. Pulling). Magnetic sound recording (on film, tape and disc, and on wire).

CME/11.—*Screen brightness* (Chairman, Prof. D. T. Harris). Method of determining screen brightness in the projection of 35 mm. film; Method of determining screen brightness in the projection of 16 mm. film; Screen brightness for the projection of 16 mm. film.

CME/13.—*16 mm. Sound-projectors* (Chairman, Major C. H. Bell). 16 mm. sound projectors.

CME/14.—*35 mm. Sound-projectors* (Chairman, Mr. E. Oram). Test films for 35 mm. sound projectors.

CME/15.—*Kinema seating* (Chairman, Mr. J. Pollard).

CME/16.—*Kinema lenses* (Chairman, Mr. E. Oram). Lenses for 35 mm. projectors; Lenses for sub-standard projectors.

CME/17.—*Standard Forms for Kinematography* (Chairman, Dr. D. F. Carter). Picture negative reports; Sound negative reports; Negative condition reports; Continuity sheets.

Particular interest was expressed in the work on magnetic sound recording in hand by Technical Committee CME/10, under the Chairmanship of Mr. M. J. Pulling, Superintending Engineer (Recording) of the B.B.C.

Overseas Liaison

Mr. E. Oram, as Chairman of the Kinematograph Industry Standards Steering Committee, informed the Industry Committee of the existing arrangements made for liaison with the Standards Organisations of other countries, and reported on discussions that had taken place recently with Mr. J. W. McNair of the American Standards Association, and Dr. Frank, the Director of the Deutsche Normenausschuss. These arrangements were felt to be adequate.

The B.S.I. Secretariat reported that this Industry Committee was the British National Committee on Kinematography of the International Organisation for Standardisation (ISO), and that the Secretariat for Kinematography of ISO was held by the United States Committee.

The Committee then considered 40 American Standards which had been proposed for international discussion, and decided on the action to be taken. Most of these standards were referred to Technical Committees for detailed consideration.

TECHNICAL ABSTRACTS

Most of the periodicals here abstracted may be seen in the Society's Library

CONTRIBUTION OF FRENCH TECHNICIANS TO KINEMATOGRAPHY.

Lo Duca, *Revue du Cinéma*, Jan., 1948, p. 43, Feb., 1948, p. 49.

Part I of this paper discusses the work of the French pioneers of the nineteenth century. Part II describes the development of sound, colour, and stereoscopy. Part III deals with the origins of the French industry. A bibliography is included. R. H. C.

SULPHIDE FOG, ITS NATURE, CAUSES AND PREVENTION.

R. W. Hennand, J. F. Crabtree, *J. Phot. Soc. Amer.*, Dec., 1947.

As is well known, the presence of sulphides in a developer in concentrations as low as 1 in 2 million may lead to fog. The authors have re-examined the causes and find that sulphides may be formed either by sulphurising bacteria or by the aeration of a developer containing sulphur compounds. The authors recommend the addition of 30 ccs. per litre of a 1% solution of cadmium chloride, followed by filtering.

M. V. H.

TWO MICROSCOPES FOR MEASURING THE DIMENSIONS OF 35 MM. FILM

O. E. Conklin, *J. Soc. Mot. Pic. Eng.*, Dec., 1947, p. 537.

In microscopes for measuring 35 mm. film dimensions, images of the edges to be measured are caused to coincide by means of an appropriate optical system, the magnitude of the error being measured by the angular setting of a glass plate. Of two such instruments, one measures the width of film and the centring, width-pitch and squareness of the perforations, while the second measures the length pitch of the film.

R. H. C.

ONE-STRIP COLOR-SEPARATION FILM IN MOTION PICTURE PRODUCTION.

H. C. Harsh and J. S. Friedman, *J. Soc. Mot. Pic. Eng.*, Jan., 1948, p. 8.

The authors describe a new Ansco film, Type 155, designed for the production of black and-white successive frame negatives from Ansco Color originals. This practice has the advantage that loss of colour saturation due to the making of second and third generation dupes is avoided, and special effects may be introduced during the black-and-white stage. The new film has been designed to produce the same gamma through red, green, and blue filters when the three records are developed together, producing balanced separations at any gamma up to about 2.0.

M. V. H.

NEW HAND CAMERA BY SIECHTA OF PRAGUE.

W. Beyer, *Filmtechnik*, Jan., 1948, p. 17.

Features of a new 35mm. hand camera are the inclined position of the magazines which with a well designed hand grip, enables the camera to be held firmly; a three-lens turret with offset lenses, which permits the use of lenses down to 28mm. focus; and direct look through to the film. The camera is powered by a 6/8 volt 20 watt motor, and weighs, with three lenses, motor and magazines, only 9 lbs.

R. H. C.

SPECIFICATION FOR CAMERA AND CAMERA STAND.

Bull. Off. de la Commission Supérieure Technique, July, 1947, p. 166.

A specification for a 300-metre camera and camera stand lays down requirements for the optical system, the shutter, steadiness, filters and diffusers, magazines, counter-driving system, synchronism, weight, and noise level. Among other requirements for the camera stand, it is required to be adaptable for pivoting either about the nodal point of the lens, or about the eyepiece.

R. H. C.

PROBLEMS OF BACK PROJECTION.

M. Raibaud, *Bull. Off. de la Commission Supérieure Technique*, July, 1947, p. 159.

A survey of the bases of back-projection covers choice of film, sensitometric requirements and characteristics of the screen (in which connection curves are reproduced showing the magnitude of the centre-to-edge brightness ratio for different camera and projector lenses). The survey concludes with suggestions for methods for minimising the latter effect.

R. H. C.

A NEW VARIABLE-AREA RECORDER OPTICAL SYSTEM.

J. L. Pettus and L. T. Sachtleben, *J. Soc. Mot. Pic. Eng.*, Jan., 1948, p. 14.

The paper deals with the optical and mechanical considerations governing the design of the optical unit fitted to the RCA type PR31 recorder and gives details of the layout and functions of the various components. A new visual monitor of the rear projection type is introduced and accessories include photo-cell monitoring and a new noise reduction shutter for push-pull recording.

N. L.

CATHODE-RAY-OSCILLOGRAPH IMAGES OF NOISE-REDUCTION ENVELOPES

B. H. Denney, *J. Soc. Mot. Pic. Eng.*, Jan., 1948, p. 37.

The visual display of noise reduction bias envelopes in relation to signal pulses is of particular value in the adjustment of variable density recording systems, and a set-up is described, in which pulses from an audio oscillator are displayed on a cathode ray oscilloscope in relation to their resulting bias envelopes by means of electronic switching. Practical examples showing the use of the system and illustrating various adjustments are given.

N. L.

LA DIFFUSION DES FILMS EN PLUSIEURS LANGUES.

A. Cottet, *Technique Ciné.*, 8th and 22nd Jan., 1948.

A language dubbing process is described based on what may be termed pre-synchronising. It requires the recording of all dialogue before photographing is commenced, a complete soundtrack being made for each proposed language version. Photography is then carried out on the set, playback fashion, with the aid of an elaborate apparatus which reproduces the soundtrack on a loud speaker, projects a moving pilot strip on which the dialogue is written, and introduces appropriate delays for action, etc. Separate takes have to be made for each language version, but the same artists may be used in each.

N. L.

INDUSTRIAL CONTROL APPLIED TO THE PROJECTION ROOM.

M. A. Boyce and C. W. Hyten, *J. Soc. Mot. Pic. Eng.*, March, 1948, p. 248.

A studio projection room is described, in which projectors, interlock, inter-communication equipment, and lighting are controlled from a press-button console.

R. H. C.

IMAGE CONTRAST WITH OR WITHOUT AN ILLUMINATED BORDER.

J. Eggert, *Science et Industries Photographiques*, Feb., 1948.

The author describes the findings of an audience in comparing the contrast of photographic prints on a white mount with the transparencies projected in darkness. In confirmation of M. Abribat's findings, an image is judged to be flatter when the surroundings are dark, which agrees with the product gamma employed in film laboratory practice.

M. V. H.

TECHNICAL ASPECTS OF TELEVISION STUDIO OPERATION.

R. W. Clark and H. C. Gronberg, *RCA Review*, Dec., 1947, p. 719.

Titles and duties of the technical personnel together with detailed information on their duties in the N.B.C. Television Studio in New York are given in this article. The special requirements of microphones, television cameras and dollies, lighting and cueing systems are briefly surveyed.

T. M. C. L.

TELEVISION REMOTE OPERATIONS.

A. H. Brolly, *J. Soc. Mot. Pic. Eng.*, Jan., 1948, p. 54.

This account of television outside broadcasting at the Chicago television station, WBKB, describes the apparatus and connections for the broadcasting of outside events within a radius of 15 miles. The cameras, amplifiers, sound apparatus and monitors are all packaged in suitcase sized units for convenient handling and the apparatus is carried in a station wagon. Under favourable circumstances, they can set up and commence television in less than one hour.

T. M. C. L.

RECENT AMERICAN STANDARDS

Recent American motion picture standards include the following:

Z22.27—1947—*Method of Determining Transmission Density of Motion Picture Films.*—The previously published standard describing methods of measurement of photographic density, **Z38.2.5—1946**, is adopted for motion picture requirements.

Z22.55—1947—*Release Prints in 2000-foot Lengths.*—The Academy standard of 35mm. release prints is adopted with minor modifications. (Further modifications are being proposed by the B.S.I.—ED.)

Z22.58, Z22.59—1947—35mm. Projector and Camera Apertures.—The S.M.P.E. 1934 standards of 0.825in. \times 0.600in., and 0.868in. \times 0.631in., are formally adopted for projector and camera respectively.

Z38.3.1—1943—*Definition of Safety Film*

—This standard is based upon the British standard of 1939, which specifies tests for ease of ignition and rapidity of burning of safety base.

Z38.4.21—1948.—*Methods of Designating and Measuring Focal Lengths and Focal Distances of Photographic Lenses.*

Z38.4.20—1948.—*Methods of Designating and Measuring Apertures and Related Quantities Pertaining to Photographic Lenses.*

Z38.4.19—1948.—*Parts of a Photographic Objective Lens.*

These three important new American standards define the focal length of the lens in more exact terms than has been the case up to the present time, and provide methods of designating and measuring apertures of photographic lenses. The terms used in describing the parts of a lens are defined.

BOOK REVIEWS

DISCHARGE LAMPS FOR PHOTOGRAPHY AND PROJECTION, by H. K. Bourne, pp. 424. (Chapman & Hall, London, 36s.)

The object of the book is to describe in detail the design, construction, operation and application of electric lamps with special reference to the photographic field. It does all these things in a most authoritative manner. It is refreshing to find an author who is both an electrical engineer and a photographer.

Although the more theoretical aspects are dealt with where necessary, this book is, on the whole, essentially practical and easily understandable. It deals in turn with incandescent lamps, the carbon arc, the various types of mercury vapour lamps (including the Compact Source), and photographic flash lamps. The practical application of these light sources to photography is well covered, and a number of useful appendices are given.

This book has appeared at a most opportune moment, since new and important light sources have emerged from the laboratory stage so quickly, that they have tended to become rather a mystery to those not actually using them. The important part that these new light sources is likely to play in the film studio suggests that this book would be of value to every

motion picture cameraman and studio lighting expert. M. F. COOPER

BRITISH FILM MUSIC, by John Huntley (Skelton Robinson, Ltd., 17s. 6d.)

The first two chapters of this book are devoted to a résumé of music in British films from the days when its main object was to drown the noise of the projector, to the present day, with sections each devoted to well known British films.

Further chapters summarise the music of documentary, cartoon and newsreel films, followed by a series of articles written by such renowned specialists as Vaughan Williams, Muir Matheson and Louis Levy, to quote but three.

Apart from the many useful pages of reference in the latter part (the biographical index in particular), probably the most interesting chapters to the technician are those in which well known American critics give their opinions of our film music, and the masterly description of William Walton's score for the film "Henry V" by another American, Stanlie McConnell.

In conclusion, may one draw attention to a short article entitled, "A Film Music Recording Session"; no one with any sense of humour who has ever been present at such a session should miss reading this reprint from *Our Time*. G. BURGESS

ROYAL PHOTOGRAPHIC SOCIETY

At the last Council meeting of the R.P.S. the following B.K.S. Members were admitted to the Fellowship: D. C. Catling, A. A. Englander, and D. Ward.

The following were among those admitted to the Associateship: A. H. Anstis, T. W.

Osborn, T. B. Thoresen, and H. Waxman.

The O.B.E. has been awarded to Mr. J. Dudley Johnston, Curator and Hon. Secretary. He was President from 1923—1925, and again from 1929—1931, and was appointed Hon. Secretary in 1938.

THE COUNCIL

Meeting of June 2nd, 1948.

Present : Messrs. W. M. Harcourt (*President*), A. W. Watkins (*Vice-President*), L. Knopp (*Deputy Vice-President*), I. D. Wratten (*Past-President*), E. Oram (*Hon. Secretary*), C. H. Champion, F. G. Gunn, R. B. Hartley, B. Honri, A. G. D. West, R. E. Pulman (*representing Theatre Division*), H. S. Hind (*representing Sub-Standard Division*), R. H. Cricks (*Secretary*), and W. L. Bevir (*Acting Secretary*).

Premises.—It was reported that owing to delays in reconstruction work, accommodation which it was hoped to obtain was unavailable at the present time. It was therefore decided to accept the temporary tenancy kindly offered by Merlin Films, Ltd., at 53, New Oxford Street, as from June 24th.

Empire Membership.—It was agreed that the Branches Committee should supervise membership within the Empire, and that a Patron Membership Sub-Committee should be formed.

British Film Institute.—Mr. Rex B. Hartley was appointed to represent the Society on Committees of the B.F.I.

Film Mutilation Brochures.—It was reported that drafts of three brochures had been circulated for comment.

Home Office Regulations.—Recommendations concerning draft Cinematograph Regulations had been approved for submission to the Home Office.

British Standards Institution.—The name of Mr. I. D. Wratten was added to the Society's representatives on the B.S.I.

Papers Committee.—Allocation of meetings for 1948/49 was confirmed as follows : Society : 7 ; Theatre Division : 5 ; Sub-Standard Division : 4 ; Film Production Division : 4 ; Joint meetings with A.C.T. : 5. Terms of reference were prepared for representatives of the Film Production Division who were meeting representatives of the A.C.T.

Journal Committee.—It was urged that the Committee should be very strict when admitting papers, and where they do not merit inclusion, a report only should be given.

Theatre Division.—It was agreed that the decision to charge for refreshments should be rescinded in respect of Sunday Meetings.

Sub-Standard Film Division.—A meeting with representatives of the R.P.S. Kinematograph Section and the Scientific Film Society had taken place to discuss a joint programme and to avoid the clashing of dates.

EXECUTIVE COMMITTEE

Meeting of June 2nd, 1948.

Present : Messrs. A. W. Watkins (*Vice-President*), L. Knopp (*Deputy Vice-President*), E. Oram (*Hon. Secretary*), I. D. Wratten (*Past President*), W. L. Bevir (*Acting Secretary*), and Miss S. M. Barlow (*Assistant Secretary*).

Election.—The following were elected :—

MISS IRENE DAWN COX (Associate), Plaza Cinema, Watford.

JAMES M. WILDE (Associate), Royal Air Force.

ERNEST FREDERICK CHINNEY (Associate), C. H. Champion & Co., Ltd.

WILLIAM CROWTHER (Member), Odeon Theatres, Manchester.

SIDNEY MAURICE YATES (Associate), Admiralty Experimental Works, Gosport.

JOHN EDWARD SULLIVAN (Member), British Lion Studio Co., Ltd.

DAVID GEORGE BRAKE (Associate), Technicolor, Ltd.

FRANCIS KENELM MACKENZIE CARVER (Member), Pinewood Studios.

Dr. J. J. v. BRAUNMÜHL (Member), British Acoustic Films, Ltd.

PETER KELLY (Associate), Times Film Co., Ltd.

LAURENCE PAUL WILLIAMS, A.R.I.B.A. (Member), Pinewood Studios.

EDWARD VICTOR HOTCHKISS (Member), Signal Films, Ltd.

FREDERICK CHARLES RICHES (Member), A. Kershaw & Sons, Ltd.

Transfers.—The following Associates were transferred to Corporate Membership :—

JAMES FREDERICK LAGDEN, Colonial Film Unit.

RICHARD WILLIAM ANDREW, Denham Laboratories, Ltd.

Deaths.—The following deaths were noted with regret :—

MARCUS M. PULVER (Member). JAN SIKORSKI (Member).

EDGAR THORNE (Associate).

RECENT ADDITIONS TO THE LIBRARY

Out of donations gratefully received, the Library committee has made the following purchases:—

A TREATISE ON LIGHT, R. A. Houstoun, *Longmans, Green & Co.*

THE PHYSICS OF MUSIC, Alexander Wood, *Methuen & Co., Ltd.*

MEASUREMENT OF RADIANT ENERGY, Editor W. E. Forsyth, *McGraw-Hill Book Co.*

PLASTICS IN INDUSTRY, "Plastes," *Chapman & Hall, Ltd.*

ELECTRONIC CIRCUITS AND TUBES, Editors: H. E. Clifford and A. H. Wing, *McGraw Hill Book Co.*

VACUUM TUBES, Karl R. Spangenberg, *McGraw-Hill Book Co.*

THE PHOTOGRAPHIC PROCESS, J. E. Mack, M. J. Martin, *McGraw-Hill Book Co.*

ELECTRON OPTICS AND THE ELECTRON MICROSCOPE, V. K. Zworykin and others, *John Wiley & Sons, Inc.*

RADIO ENGINEERING HANDBOOK, Editor: K. Henney, *McGraw-Hill Book Co.*

PHOTOGRAPHY, L. P. Clerc, *Sir Isaac Pitman & Sons, Ltd.*

STANDARD HANDBOOK FOR ELECTRICAL ENGINEERS, Editor: C. E. Kenneth Mees, *Macmillan Co.*

Books which have been accepted, with thanks, by the Library committee include: MAGIC SHADOWS, Martin Quigley, Jr., *Georgetown University Press.*

A TIZEVES MAGYER HANGOSFILM, 1931-1941, Lajta Andor.

FILMUVEZSZETI EVKONYU, 1948, Lajta Andor Az OTVENEVES FILM, Lajta Andor.

PENGUIN FILM REVIEW, Nos. 3 and 5.

FILM, Roger Manvell, *Penguin Books, Ltd.*

BRITISH JOURNAL PHOTOGRAPHIC ALMANAC, 1948, *Henry Greenwood & Co., Ltd.*

THE KINETRADOGRAM, Vol. 1, Kinematograph Trading Co.

RUNDFUNK ROHREN, 1937-1938, L. Ratheiser, *Roth & Co., Berlin.*

MIRACLE OF THE MOVIES, Leslie Wood, *Burke Publishing Co., Ltd.*

BRITISH FILM MUSIC, J. Huntley, *Shelton Robinson.*

SOUND AND DOCUMENTARY FILM, Ken Cameron, *Sir Isaac Pitman & Sons.*

GRAMMAR OF THE FILM, Raymond Spottiswoode, *Faber & Faber, Ltd.*

Volunteer help is always needed in the Library, which is open until 8 p.m. on Mondays and until 5.30 p.m. from Tuesday until Friday.

PERSONAL NEWS of MEMBERS

Members are urged to keep their fellow members conversant with their activities through the medium of British Kinematography.

F. W. BAKER has evolved a plan to ensure the controlled production of British films at the Paignton Studios.

DARREL CATLING is now convalescing after an operation for appendicitis.

RONALD HAINES has arrived at Narvik, having travelled 2,000 miles on a filming cruise. He visited the Fresian Islands, North Germany, Denmark, and Southern Sweden on the route.

MALCOLM V. HOARE has accepted a technical appointment with Kay Laboratories, Ltd. He will continue his part-time work at the Polytechnic.

CECIL KERSHAW has been made a C.B.E. for his services in the production of optical instruments.

PERCY PILGRIM has been elected General President of the National Association of Theatrical and Kine Workers.

PERSONAL ANNOUNCEMENTS

Engineer-salesman required by important equipment distributors in South America, having first-class knowledge projectors and sound reproducers and preferably some acquaintance recording and cameras.—Reply with full details experience, age, knowledge Spanish or Portuguese, present salary, to Box 86168, British Kinematograph Society, 53, New Oxford Street, W.C.1.

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Announcements are accepted from Members and Associates. Rate 4d. per word.

J. W. CAMPBELL, M.I.B.E.

Died May 9th, 1948.

Mr. Campbell was a designer of 16mm. sound projectors, and was a director of Sub-Standard Equipments, Ltd. He had been connected with the industry for the whole of his working life. He had been an Associate member of the B.K.S. since 1945.

B.K.S. JOURNAL. A few bound volumes of the B.K.S. Journal, 1947 (Volumes 10 and 11) are available, price £2 2s. British Kinematograph Society, 53 New Oxford Street, London, W.C.1.



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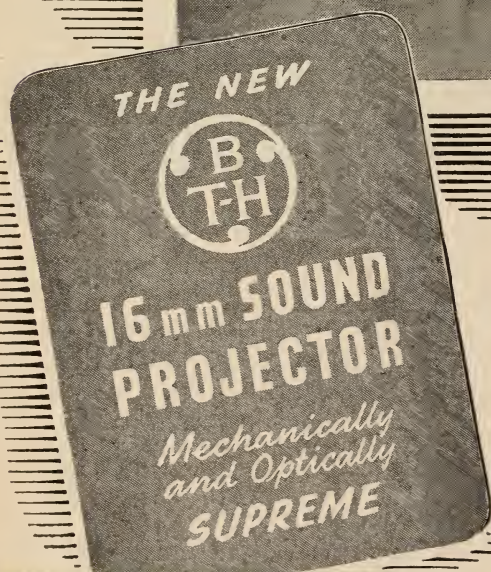
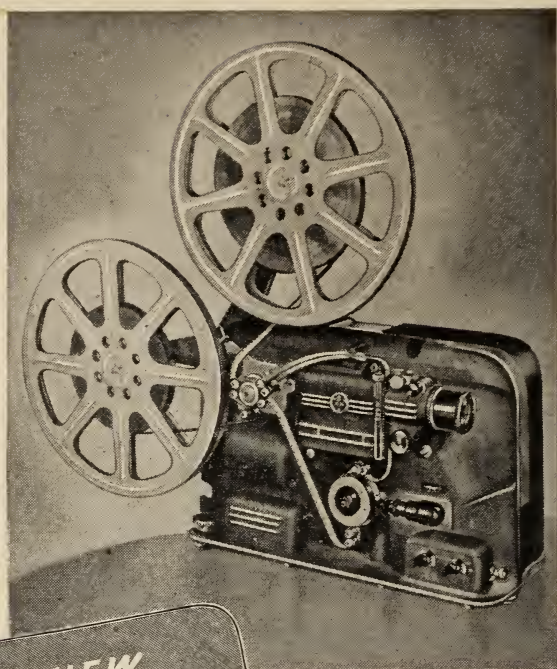
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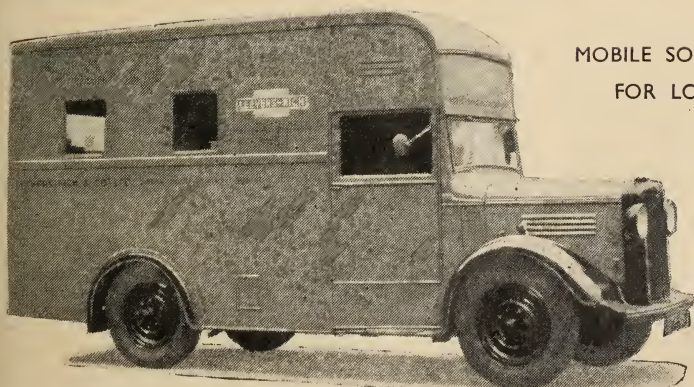
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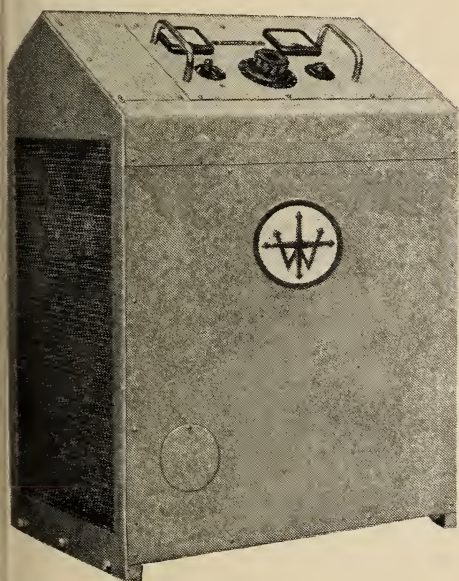
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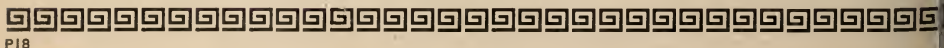
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The Journal of the British Kinematograph Society

VOLUME THIRTEEN, No. 2.

AUGUST, 1948

REVERSAL PROCESSING

Ir. H. Verkinderen*

Read to the B.K.S. Sub-Standard Film Division on December 10, 1947.

REVERSAL processing and reversal film have, so far, played an insignificant part in professional cinematography. Although now and again reversal processing has been applied for carrying out special processes, yet in the main it may be assumed that the professional laboratories have had no practical experience of the reversal process. Nevertheless, the reversal process leads to some very interesting results, and it may be expected that it will find some application in professional cinematography of the future, especially in connection with colour processes.

In the first place, reference will be made to some advantages of the reversal process, after that to the characteristics of the sensitometric curve, and finally to reversal processing itself: the composition of the principal baths and their influence on the shape and position of the sensitometric curve. It is not intended to enter upon any theoretical dissertations on this matter, but rather to give a survey of what can be attained with reversal film, also of the practical means at our disposal to reach the end in view.

I. MERITS OF REVERSAL PROCESS

The reversal process offers certain well defined advantages against the negative-positive process. These advantages are: a finer grain, freedom from fog, sharpness of image, and absence of dust spots.

Absence of Graininess

The fineness of grain of the reversal film is generally attributed to the fact that the heaviest grains of an emulsion prove to be the most sensitive, and therefore are developed by the first exposure and the first development, so that for the second development and the formation of the reversal image the finer, less sensitive grains remain.

It should be pointed out, however, that if by a first development a coarser grain is developed, the result will be that this graininess will also, although to a minor degree, become apparent in the reversal image, due to the fact that the latter is composed of remnants of silver halide of the first development. To obtain a fine grain in the reversal picture it is therefore necessary that the graininess should not be excessive in first development.

It can also be said that the graininess of the reversal picture is solely dependent on the composition, and more especially on the duration, of the first

*Gevaert, Ltd.

development: the second development plays practically no part in the matter. For instance, consider the case when the first developing-time is doubled; this will give rise to a very noticeable increase of the graininess in the reversal picture, whereas the use of a fine grain bath for the second development has practically no influence on that graininess.

Effect of Copying

That in the main the reversal picture shows a much finer grain than the negative-positive picture, is for the major part due to the fact that in the reversal process no copying takes place. It is well known that copying always results in a heavier graininess, that the graininess of the positive copy is considerably heavier than that of the negative used for printing, and that this graininess becomes heavier still when, in between the original negative and the ultimate positive, duping is multiplied several times, as is normally the case when using Duplicating Negative.

This increase in graininess consequent on copying is mainly ascribable to the defective resolving properties of Duplicating and Positive films. In recent years this has been considerably remedied by the use of low-speed Fine Grain Duplicating and Positive material. Yet copying still remains a cause of increase in graininess, and the fact that in the reversal process no copying is done is one of the principal reasons why a reversal picture, obtained under normal circumstances, always results in very fine grain.

Absence of Fog

A second advantage of the reversal process is the total absence of fog, at least when the reversal process is carried out correctly, as will become apparent in due course. This absence of fog naturally has the sequel that the images when projected gain considerably in clearness. The absence of fog is of capital importance in connection with the sound-track.

Image Sharpness

A third advantage of the reversal process is the sharpness of the image. This is attributable to the fine grain previously mentioned, to the absence of fog, to the shape of the sensitometric curve, as well as to certain development effects that very often occur with contrasty baths, such as are used for the reversal process. The fact that no copying is done in the course of the reversing process is also a cause of the image sharpness of the picture.

The improved sharpness of the image and the lack of fog result in an extraordinary plasticity of the reversal pictures, in comparison with the negative-positive pictures, which is noticeable on the projection of a good amateur film or of a miniature film obtained by means of the reversal process.

Absence of Dust Spots

A fourth advantage of the reversal film, of major importance to the amateur, is the lack of white dust spots in the film. When speaking about dust and dirt on a film, discrimination should be made between black dust marks and white ones. The black dust spots are attributable to dust adhering to the film itself, *i.e.*, either that the dust particles were present in the emulsion, or else that this dust attached itself in the course of manipulation of the film. This dust hardly creates a disturbing effect if present on a well-filled picture.

The white dust spots originate during copying, either through black dust marks in the negative film, or through dirt adhering during copying between the negative and the positive. These white dust marks are a nuisance when projecting, and all professional kinematographers know only too well what it costs to avoid, or at least reduce them to a reasonable quantity. In an

amateur laboratory it is practically impossible to take the many expensive precautions required to avoid them.

However, as these dust marks originate only when copying, they are totally absent from a reversal film, unless they originated at the moment of shooting, due to dirt on the film or in the camera gate.

The use of the reversal process for certain purposes in professional cinematography could render great services, and the more complicated manipulation would be amply rewarded by the elimination of a copying process as by the use of the reversal process for making dupes. Incidentally, it may be pointed out that in colour-films each copying step results furthermore in a degradation of the colours, so that, especially in the case of colour films, the elimination of a copying step is of prime importance.

Important Drawbacks

Against these advantages of the reversal process *versus* the negative-positive process there are, naturally, also important drawbacks. The first one lies in the more complicated development process, and the fact that the ordinary developing machines are not suited for this kind of work. The process could eventually be carried out on ordinary developing machines provided it is carried out in two steps, as on two different machines. As by the use of the reversal process, for example in duplicating, one reversal film replaces two other films, the operation would not be so much more expensive than with the ordinary process, whilst, furthermore, the advantages would still be retained resulting from the elimination of a copying step.

The principal disadvantage of the reversal process, however, is a lack of latitude in exposure. In principle, shots on a reversal film do not allow a latitude of exposure if the development is carried out in a standard method, although there are various ways of saving a reversal film that has been wrongly exposed. Latitude of exposure is of no importance when using reversal film as an intermediate material in the laboratory, where the exposure can be precisely regulated. Neither has positive film by a standard development any latitude of exposure.

II. REVERSAL PROCESSING METHODS

The method in which the reversal process is carried out may be summarised as follows.

The reversal film which has been exposed, either in the camera or in the printer, is first thoroughly developed in a vigorous developer. By such development it must be understood that the emulsion within the area of the total exposure is developed to the highest density attainable, that is to say, that in this area, after developing, absolutely no reducible silver halide remains. In practice this can only be attained by adding a solvent of silver halide to the developer. This development naturally results in a somewhat strong fog, and the presence of a solvent of silver halide leads moreover to the formation of a dichroic fog, so that ultimately the sensitometric curve of the film after such a first development appears as is illustrated by Fig. 1. After this first development usually follows a stop-bath, which at the same time acts as a hardener. This hardening is in most cases necessary because the lengthy manipulation required by the reversal process would otherwise occasion a softening of the gelatine layer. As a stop-bath, the well-known solution of 3% chrome alum may be used.

After the stop-bath the film is thoroughly washed. It is indeed imperative that all the developing products be eliminated, in view of the danger that, due to oxidation in the following bleaching bath, these may create a brown stain which cannot be removed.

Bleaching

The negative picture is then oxidised into a soluble salt. As oxidation media, use is generally made of either potassium bichromate, or potassium permanganate, or else a mixture of both; whilst as an acid, sulphuric acid is employed. The silver in such a bath is ultimately changed into silver sulphate, which can be removed by washing.

As the remaining silver halide in those baths loses practically all its sensitivity, the bleaching process can be followed by fairly strong light. Bleaching is complete when the back surface of the film has taken the tint of the original emulsion.

After bleaching the film is once more thoroughly washed, and put in a clearing-bath for the purpose of neutralising and dissolving the last remnants of the bleaching-bath, and at the same time in order to render the remaining silver halide sensitive. As the clearing-bath use is made of a solution of sodium sulphite if bleaching took place by means of bichromate, or a solution of bisulphite if permanganate was used for bleaching.

Second Exposure

At present the film shows a positive picture, built up of silver halide. This silver halide is exposed to a strong diffuse light source—this is the so-called second exposure—and thereupon follows a new development in an ordinary metol-hydroquinone developer. During this development the silver halide is developed in accordance with a curve which is exactly the opposite of that of the first development. This curve appears as illustrated by Fig. 1.

After this development a short fixing is applied for the purpose of removing remnants of silver halide, whereupon washing and drying takes place.

III. SENSITOMETRIC CHARACTERISTICS

Upon studying somewhat more closely the density curve of the reversed film, the following characteristics are noticed.

As a rule a straight horizontal line is drawn representing the total density that could be attained with the film in question if all the silver halide present in the emulsion turned black. The actual maximum density of the reversed film, however, is lower, as it is necessary to deduct from the total density both the fog and the dichroic fog developed in the course of the initial development. This maximum density is a variable one, and depends on the composition of the initial developer and duration of the first development.

After the horizontal line, representing the actual maximum density, and connected thereto with a more or less short shoulder, follows the slope of the curve corresponding with the straight line of an ordinary negative or positive curve. At the end of this straight line follows the toe of the sensitometric curve, which connects the straight line with the abscissa, at least if the film on first development was developed thoroughly.

With the reversal curve the gradation is also represented by the gamma of the straight line, as is the case with negative film. However, to determine the speed it is impossible to apply the criterion as customary for negative film.

Speed of Reversal Film

If the same criterion were taken for reversal film as for negative film, then the point determining the speed would lie at the intersection of the horizontal line of the actual maximum density and of the straight line, that is to say at point A of Fig. 1. It should be taken into account, however, that reversal film, at least as far as it concerns camera film, must also be projected, and that by normal projection all density-discrimination for densities exceeding

from 2.2 to 2.4 is lost. Consequently, point A can be taken as a criterion for the speed only if the actual maximum density does not lie above 2.4. Should, for instance, this actual maximum density lie near density 3 or higher still, then point A can no longer come into consideration for determining the speed.

On the other hand, if the actual maximum density does lie in the neighbourhood of 2.4, even then point A cannot be accepted as a criterion for the speed. Indeed, let us assume that two scenes are shot in succession and that for the first scene the light-range corresponds with a difference of Log. Exp. of approximately 1.0, whilst for the second scene the light-range corresponds with a difference of Log. Exp. of 2.0. For the first scene the density will stretch from point A to point X, *i.e.*, an average density (for $\gamma=1.2$) of 1.8. For the second scene the density will stretch from point A to point Y, *i.e.*, an average density of 1.2. It therefore becomes evident that in this manner the consecutive scenes would vary appreciably with regard to the average density, which on projecting would create a most unpleasant sensation.

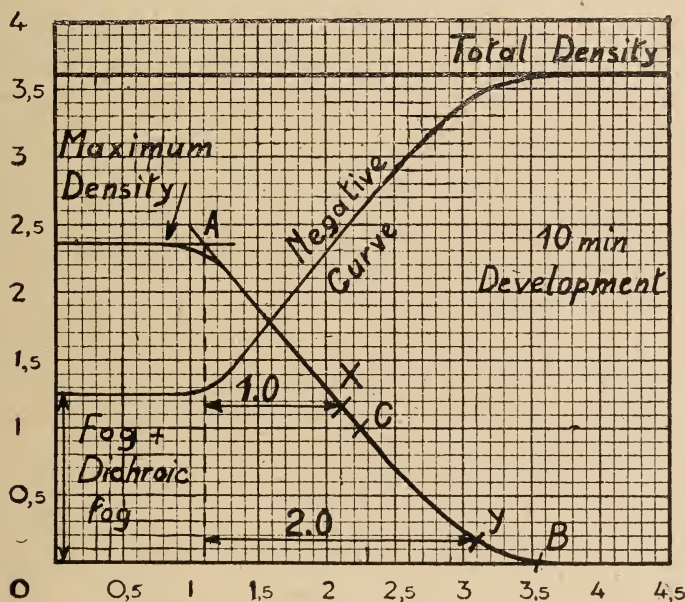


Fig. 1. Sensitometric Curves of Reversal Process.

Another method to determine the speed was proposed by Smethurst. He suggested that the point B should be taken as criterion for the speed, *i.e.*, where the density of the reversal curve falls on 0. In the opinion of Smethurst the totally white parts of the picture should be rendered by density 0 at the end of the curve. This system, of course, presents the same disadvantage as does the previous one, and leads to notable differences in the average density of consecutive scenes when the light-range varies strongly from one scene to the other. Of this Smethurst was well aware, and therefore he proposed that for particular cases, such as landscapes, where the light-range is rather low, the exposure should be reduced by a well defined factor.

Assessment of Speed

According to the author's conception, neither of the two preceding criteria for determining the speed of the reversal film is acceptable, for the reason that neither gives any consideration to the fact that the film after having

been reversed must be projected. In projection where no special effects are aimed at, it is desirable that the average density of consecutive scenes should not vary too much. This is one of the reasons why, for instance, the criterion of speed of a positive film is never taken at the beginning of the curve, but at density 1, which may be considered as being approximately the average density of positive prints. Consideration is given to the toe of the curve of the positive only for obtaining the desired picture quality, but never for determining the speed. As the reversal films should be exposed and developed in such a manner that they can be projected, it is the author's opinion that as criterion of speed should be taken *the point of the density curve corresponding to the desired average density*, for example, 1.0 or 0.9.

The exposure which corresponds with this point varies according to the bath used as well as the time of the first development. The first development should be pushed only so far that the actual maximum density does not drop below density 2.4. Therefore, it would be advisable to take as criterion of speed that point on the abscissa that corresponds with density 1.0 or 0.9, by a development in the first developer recommended by the manufacture, and for a time of first development whereby the actual maximum density is kept down to 2.4.

IV. VARIABLES IN PROCESS

There are three operations in the course of which the reversal sensitometric curve can be influenced, namely the first development, the second exposure, and the second development. It is especially by variations in the composition of the first developer and in the time of the first development that notable variations of the sensitometric curve can be obtained.

Variations in First Development

Both the time of treatment and the composition of the bath can be changed. A first developer for reversal film contains :

- (a) Developing products, usually Metol and Hydroquinone ;
- (b) An alkali, being normally Sodium or Potassium Carbonate ;
- (c) A sulphite ;
- (d) Potassium Bromide ;
- (e) A solvent of silver halide.

TABLE I.

First development time in minutes		Speed : Log. Exposure at D=1.0		Contrast		Maximum Density		Minimum Density	
		5	10	5	10	5	10	5	10
Concentration in grammes p/lit. Metol Hydro- quinone									
0.0	10.0	—	3.0	1.2	1.4	3.7	3.0	1.4	0.3
2.0	8.0	2.6	2.0	1.6	1.6	3.0	2.5	0.0	0.0
3.5	6.5	2.6	2.0	1.5	1.5	2.9	2.35	0.0	0.0
5.0	5.0	2.6	2.0	1.2	1.2	2.8	2.2	0.0	0.0
6.5	3.5	2.85	2.2	1.1	1.1	2.9	2.3	0.2	0.0
10.0	0.0	3.5	2.9	1.1	1.1	3.2	2.6	0.6	0.2

Variations in the quantity of the carbonate and sulphite, provided these do not lie below a minimum, have an influence only on exhaustion and keeping qualities of the bath. They exercise practically no influence on the shape or the position of the sensitometric curve, and may therefore be left out of consideration.

There remains to be examined the influence of the developing products used, of the potassium bromide and of the solvent of silver halide.

Metol-Hydroquinone Ratio

In the tests carried out with Panchro Reversal film the total quantity of metol and hydroquinone amounted to 10 grams per litre. For these tests the quantities of potassium bromide as well as of the solvent of silver halide were kept constant at 5 gr. per litre. The results are given in Table I. As is apparent from the results obtained, it is essential to have a mixture of metol and hydroquinone to get a thorough development. With metol or hydroquinone alone, it is not possible to obtain a thorough development. Furthermore, hydroquinone alone gives a marked loss of speed against that obtained by a mixture of the two developing products. It further appears that with the film under consideration a thorough development can be obtained with all mixtures of metol and hydroquinone, and that by varying the proportion of metol against hydroquinone a notable change in gamma will occur; that change in gamma goes from 1.1 to 1.6.

Speed as defined above remains practically constant with all proportions of metol and hydroquinone used, for the same time of treatment. However, when doubling the time of treatment, speed increases by $\log^{-1} 0.6$, i.e., four times.

Silver Solvent and Bromide

Varying the solvent for silver halide, the results as shown in Table II were obtained, by using potassium thiocyanate as solvent. Without solvent thorough development is not reached. By increasing the amount of solvent above 5 gr. per litre, the maximum density drops rapidly without a noticeable gain in speed. Below 5 gr. per litre the speed drops rapidly and thorough development is only obtained by longer treatment.

Varying the quantity of bromide gives the results as shown in Table III.

TABLE II.

First development time in minutes	Speed : Log. Exposure at D=1.0		Contrast		Maximum Density		Minimum Density	
	5	10	5	10	5	10	5	10
Solvent for Silver Halide in grammes/ Litre								
0	3.3	2.95	1.6	1.6	3.4	3.15	0.65	0.30
2	3.0	2.5	1.6	1.6	3.35	3.0	0.50	0.10
5	2.6	2.0	1.6	1.6	3.0	2.5	0.0	0.0
7	2.5	1.9	1.4	1.4	2.5	1.9	0.0	0.0
10	2.3	1.6	1.3	1.3	2.0	1.15	0.0	0.0

With no or little bromide, speed slightly increases, but the maximum density drops below the accepted limit of from 2.2 to 2.4. Increasing the bromide content from 5 to 10 gr. gives practically no variation in the characteristics of the sensitometric curve. This fact proves that the increase of bromide content of the bath with exhaustion does not diminish the speed or alter the gamma of the reversal film.

In short, we can say that by varying the proportion of metol to hydroquinone, speed and gamma can be varied within acceptable limits, while for silver halide solvent and bromide, there is an optimum content which, of course, can vary from emulsion to emulsion.

Variation in Second Exposure

Variation in second exposure is intended to increase the latitude of first exposure, and could replace variation in the time of first development. The idea is that the remaining silver halide is more or less under-exposed, and that as a consequence it is not wholly developed afterwards. This system seems very interesting indeed, but in most cases there are special unexplained effects that occur.

For instance, in the case of the film under consideration, when bleaching is done with permanganate and clearing with bisulphite, there occur double reversal phenomena, caused by the fact that the silver halide which was unaffected during the first development proves to be less sensitive than the other. Thus a reversal curve is obtained as shown in Fig. 2, the dark parts of the image being negative, while the light parts are positive.

With bichromate and sulphite, this double reversal does not occur, but in that case for low second exposures, the pictures become too contrasty as shown in Fig. 3.

There are several patents on this subject; one of them recommends the addition of silver ions to the bleaching-bath, and this in fact improves the results obtained when bleaching with permanganate.

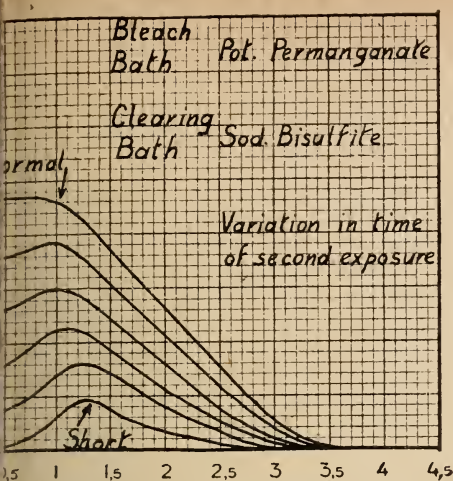
Variations in Second Development

There is yet one other method whereby the characteristics of the sensitometric curve can be altered, namely, by changing composition and developing time of the second developer.

When using a diluted second developer or another slow acting developer (low pH), then the gamma of the sensitometric curve can be lowered to some

TABLE III.

Development time in minutes	Speed : Log. Exposure at D=1.0		Contrast		Maximum Density		Minimum Density	
	5	10	5	10	5	10	5	10
Concentration of Pot. Bromide in grammes/Litre.								
0	2.3	1.6	1.1	0.8	2.0	1.2	0.0	0.0
2	2.45	1.85	1.4	1.3	2.3	1.9	0.0	0.0
5	2.6	2.0	1.6	1.6	3.0	2.5	0.0	0.0
10	2.7	2.1	1.6	1.6	3.1	2.6	0.0	0.0



2. Effect of Variation of Second Exposure—bleaching in Pot. Permanganate.

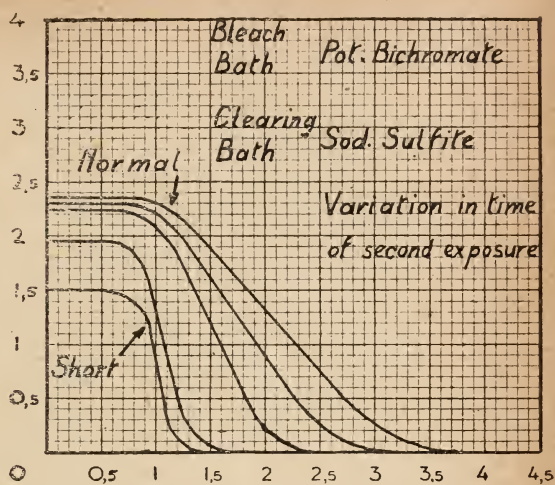


Fig. 3. Effect of Variation of Second Exposure—bleaching in Pot. Bichromate.

extent by stopping the development before completion. This, of course, has an effect only on the gamma of the finished picture.

DISCUSSION

Mr. N. LEEVERS : There seem to be two methods open to us at present for producing copies for projection : we may either make a direct dupe by the reversal process, or, alternatively, make a fine-grain negative from which release prints do not comply with the S.M.P.E. standard for 16mm. release copies, since they require to be projected with the emulsion away from the screen. In view of the fact that many sound projectors have no means of re-focusing sound optics to the non-standard emulsion position, it seems to be necessary to use one or other of the second generation copying methods.

THE AUTHOR : The best way is to take the dupe negative from the master positive.

Mr. SEARLE SHIRLEY : Can Panchromosa special negative be satisfactorily used in a reversal process ?

THE AUTHOR : Gevaert Panchromosa special cannot be reversed, because it has two emulsion layers. The first layer does not take any density in the first processing, and serves as a screen between the base and the sensitised layer.

Mr. N. LEEVERS : Could you tell us in what main respects the emulsions sold for reversal use differ from those sold for standard negative use ?

THE AUTHOR : Generally speaking, ordinary negative cannot be reversed ; it would have too low a gamma. You could,

of course, succeed by using sufficient silver solvent, but you would have low gamma and coarse grain.

Mr. H. S. HIND : Have you had any experience of developing picture and variable density sound track on the same film ?

THE AUTHOR : We have never had occasion to develop variable density on reversal film. Several times we have developed variable area on reversal film, and that has always been of good quality. The gamma is not exactly what you want for variable density.

Mr. N. LEEVERS : Would it not serve the same purpose if the original track, recorded as a master for printing from, were processed to a lower gamma than 1 ? Your product gamma would be near enough to the required figure.

THE AUTHOR : Certainly.

Mr. N. LEEVERS : With the reversal colour process we find that there is considerable image spread in the duping, and as a consequence, we have to record tracks with a considerably higher density, as a negative from which copies are to be duped, in order to balance out the image spread and consequent distortion at high frequencies. Do you find that same image spread with the black-and-white reversal process, or is it less ?

THE AUTHOR : It is non-existent. Do not forget that with a colour film you have three layers, and in many cases intermediate layers. But when you talk about black-and-white, you have only got one layer, and a very thin layer.

SET CONSTRUCTION METHODS

John Gow*

Read to a joint meeting of the British Kinematograph Society and the Association of Cine-Technicians on Oct. 22, 1947.

AS a first step in the construction of a set for a film, the Art Director studies his script in order to ascertain the action of the artists, and their movements within the set. He then makes small sketches to develop his ideas, and eventually creates his finished drawing, the approximate size of which is 24 inches \times 18 inches, which he submits to the producer and to the director.

When the sketch has been approved, plans and elevations are prepared. Normally a figure or piece of furniture in the sketch gives the approximate scale and proportions of the set. From the plan and elevation a mock-up model is made. This model is closely examined, to ensure that the set provides the correct camera coverage.

The Art Department

Draftsman in the Art Department, who are responsible for these drawings, must have a clear knowledge of set construction, and of the standard components, such as stock flats, rostrums, doors, windows, and tubular erections. They must also know the media in which the set is to be constructed, and be able to give the Construction Department information on whether parts are to be in plaster or wood, the finish of paint work, floor coverings, and so on.

Where possible, stock units are used. These consist of both smooth and rough flats of different sizes. These are normally constructed of plywood on a timber framework. The rough flats are used for plaster walls which, when stripped, can be used again.

Rostrum tops are usually of two sizes, 12 feet by 6 feet and 6 feet by 4 feet; they are normally used for pavements, or on tubular scaffolding, and for the most part mounted on felt to reduce noise. They may be used for landings at the top of staircases, and other similar purposes.

The Carpenters' Shop

In the studio carpenters' shop, construction practices are similar to those in outside joinery shops, but with certain differences. Practical windows and doors are usually correctly constructed, sash windows provided with weights, doors mortised and tenoned; but often light mock-up imitations are required, which are not to be practical, but purely dummies. Doors, for instance, may be constructed of plywood or Essex board, with a light batten framework and applied mouldings and architraves.

Staircases are more complex. A normal staircase is constructed by the carpenters, but enrichments are added by the plasterers. Balustrading may be in wood or plaster, depending on period and décor. Wrought-iron balustrading can be reproduced in fret-cut plywood, and reinforced with occasional iron supports or straps. The handrail may be in wood or plaster; plaster is used where a curved rail is required, with wood for the straight runs, depending on the type of staircase.

The Plasterers' Shop†

The plasterers, whose medium is a quick drying and very plastic one, can readily reproduce brickwork, stonework, cornices, enrichments, panelling, etc.

*Production Facilities (Films), Ltd.

†See *Brit. Kine.* Nov, 1947, p. 150.

In order to reproduce such items as carvings, sculpture, and enrichments, originals have to be modelled in clay, and moulds taken from them. These moulds may be of several types; where the enriched modelling has undercuts, gelatine or plastic moulds are normally used. The gelatine or plastic is heated until it is in a liquid form, and is then poured over the clay model and allowed to set; then a plaster shell is made around this, and the clay model extracted. Plaster is then poured into the cavity, and when set is withdrawn. Any number of casts can be made from one mould.

A piece mould is occasionally necessary. This mould may sometimes require as many as thirty or forty pieces. Each section is made in such a way that it may readily be removed from the clay model or plaster cast, yet it must key into its adjoining pieces, the pieces being retained in position by an outer sheath of plaster. Numerous casts can be taken from this type of mould.

Plain runs of mouldings are produced by using a zinc template reinforced with wood; on the bench is fastened a beading or batten, which allows the template to run the length of the bench like a slide. Plaster, reinforced with

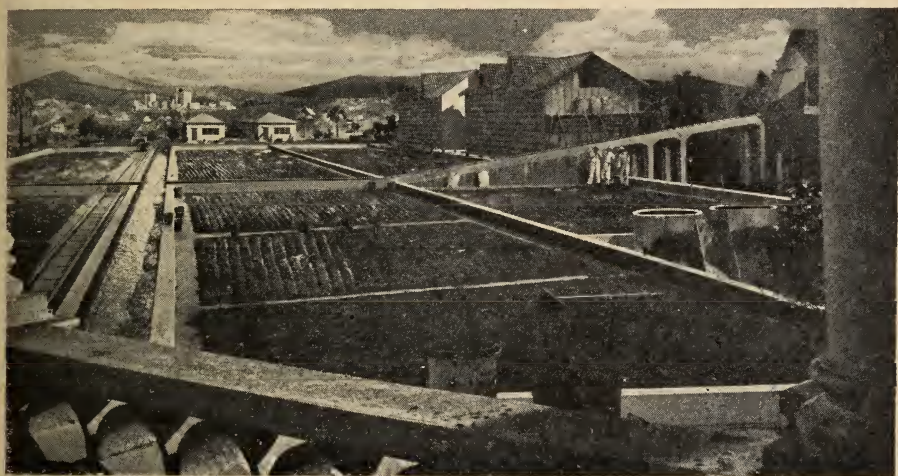


Fig. 1. Set built in Forced Perspective. The actual depth of the Set was 45ft.

hessian or scrim, is poured on to the bench, and the tool is run up and down the bench, cutting the moulding into the plaster. This, when set and shellaced, is the mould from which many reproductions can be cast.

Plaster is a very important medium in set construction; paving stones, cobbles, sets, cornices, architraves, pediments, and even furniture have been made in plaster. The plasterers take an enormous amount of trouble to get the details correct; brickwork has its correct courses, and air bricks are added. Sawdust or sand may be applied to give an aged effect.

The plasterers also play an important part in reproducing miniature work, hanging miniatures, and perspective sets. With all miniature work, modelling has to be very carefully executed. Enrichments must be carefully worked out beforehand, and the miniatures have to be true replicas of the full size, especially when used between camera and set.

The engineers and foundrymen have to produce the castings of door handles, finger plates, iron brackets for hanging signs, and all kinds of mechanical equipment.



From "The Rake's Progress," by courtesy of Independent Producers Ltd.

Fig. 2. The Set of Fig. 1 built into a Composite Set.

Set Components

Components for sets are built in the several workshops, and may be partially erected before being transferred to the stage where they are completed. There have been numerous devices made for securing these units to the studio floor; in certain studios they are used, but in others it is found that a piece of batten and a few nails is sufficient.

An important point is the mobility of wall flats or units. A set may be photographed from one angle, then later may have to be approached from a different angle, which may necessitate the removal of a wall unit. Different devices are used: for instance skates or wheels are attached to the flats, so that at very short notice they may be removed, and the camera and sound crews can then move into position.

Beams in set construction are usually a nuisance to sound crews, because they get in the way of the boom. They are, therefore, usually made removable. They are, for the most part, rested on the opposite walls, but attached by chain tackle to the gantry, so that they may be lifted from the set when not visible in the camera field. As much as half a set has been removed, in order to get the camera and sound boom into new positions.

The Paint Shop

The Paint Shop workers have a complex task. The painters have to study the needs of each cameraman, or be given the information from the Art Director. This is because each cameraman has his own individual ideas on the colour and texture of wall finishes. Some prefer to have their sets in colour, others in tones of grey.

The painter is responsible for such things as preparing walls and floors, and painting or spraying all wall finishes, glazing of windows, and sign-writing. To produce lead lights for windows a stiff mixture is squeezed on to the glass by means of an icing gun, or alternatively colour is stencilled on to the glass to form the required pattern. Any colouring is applied on the back of the glass in transparent colours. Bottle-glass effects may be reproduced by the addition of cast Perspex to the glass.

The painter has to be a first-class craftsman, with a wide knowledge of his medium. He has in most cases to use quick drying-paints, varnishes and distempers. He has to be an expert in the ageing of all wall finishes, either with a brush or spray gun.

Occasionally, it has been found impossible to purchase a wallpaper of a desired design, and the Paint Shop has reproduced this by using the "silk screen process." Briefly, this makes use of a wooden frame, across which a sheet of silk is stretched, on which a stencil has been produced; when placed face down upon the paper coloured inks or dyes are squeezed through the clear sections of silk. Two or three colours may be used, but each colour requires its own stencil. Patterned curtains may be reproduced in the same way. Both wood-block printing and lino cuts have been used. Marbled papers also may be prepared; these are obtained by drawing a sheet of paper over a tank or tray of water, on to which oil colour has been floated.

Limitation of Supplies

A difficulty nowadays is the limitation in supplies of materials. Before the War there were many boards very suitable acoustically for set construction, but to-day the limited supply of plywood and wall boards has had to be overcome by the introduction of other methods of construction, many of which are not acoustically ideal, and surfaces have had to be broken up by using openings, buttresses and other tricks, in order to assist sound recording.

It is hoped that in the near future new materials, possibly plastics, will be available to assist all concerned in set construction to produce quality work more quickly and efficiently.

DISCUSSION

Mr. BAX: I would like to know more about these new devices for supporting flats and ceiling joists.

THE AUTHOR: Numerous devices have been tried: metal telescopic supports for supporting flats, fitted by coach-bolts or screws to floor; clamps consisting of two units, one fixed to each flat, a locking unit keying them together (the defect is that the locking piece gets lost); also the "Speller Roller," a lifting device on wheels for removing flats from the main structure.

A VISITOR: What research is going on in regard to plastics to replace wood?

THE AUTHOR: Research is considerable in this field, but excessive cost prevents use of this material at the moment.

Mr. LASSALLY: What is your opinion of the use of the Independent Frame process?

THE AUTHOR: It has a lot of advantages: saving of floor space due to built sets on mobile rostrums, quick changeover from one set to another, speed of shooting increased through pre-planning and use of process projection.

Mr. T. S. LYNDON-HAYNES: Can you tell us whether you think we are getting full value on the screen from the average set? Often you get a good set on the floor, and it does not come out on the screen.

THE AUTHOR: I feel that the set is primarily a background to the artist to add atmosphere and mood, and should not be overdone, otherwise it detracts from the artist.

Mr. ADAMS: Can you tell me how process projection will affect the future Art Departments?

THE AUTHOR: The Art Departments will have more work, as every set-up has to be pre-planned.

Mr. ALLEN: Can you tell us more about perspective sets?

THE AUTHOR: The use of perspective in set construction is mainly for space saving—to produce in a space of, say, 100 ft. a set representing 300 ft. or 400 ft. To do this the area in which action is to take place is built full size and beyond this area diminished by ramping the floor and diminishing the heights of buildings. There is another aspect. Some Art Directors, when sketching, produce a drawing which can only be reproduced with a lens equivalent of approximately 24mm. or 28mm. If this effect is reproduced with a 50mm. lens you get an unnatural perspective.

Mr. BAX: What research is going on to get the humidity you get on a 500ft. street, reproduced possibly in 20 or 30ft. in the studio?

THE AUTHOR: Atmosphere can be assisted by lighting, depth of focus of lens, the use of artificial mists, and net.

Mr. W. BLAND: Have you found that if you use plaster instead of wood, you get awkward reflections? If you get the soft substitute you are looking for, is there a danger of getting H.F. attenuation?

THE AUTHOR: Yes, except that you have your texture which is normally painted, which gives a surface reflection which is fairly hard, or it is papered and again painted. With plaster you get too much resonance, especially if you have a set that is three-sided.

LIGHT EFFICIENCY OF 16mm. PROJECTORS

Walter Buckstone, F.B.K.S.*

Read to the B.K.S. Sub-standard Film Division on February 4, 1948.

IN presenting this paper the author wishes to make it clear that the views expressed are his personal views. His work does not bring him actively in touch with design or manufacture, and because of this he feels more free to express opinions than the optical, mechanical and electrical experts who have done, and still are doing, so much to improve 16 mm. equipment.

The light efficiency of the projector is a subject of more than academic interest, as it concerns the ultimate result of all our varied efforts. If, due to one or more causes, the picture on the screen is insufficiently lighted, the work of every person connected with the production suffers. In this paper it is hoped to review in some detail the links in the chain between the intake fuses and the eyes of the audience, so that we can account for the ninety-nine per cent of the light energy that does not reach the eyes of the people who are watching the screen.

Analysis of Light Loss

Starting with a supply voltage in the 200/250 range, a little more than 50% is lost in the resistance, which reduces the voltage to 100—the usual voltage for a 16 mm. projector.

This loss can be reduced to about 15% by the use of a transformer, if an A.C. supply is available. In the lamphouse we probably lose 80% to 90% of our light, as the condenser collects only a small bundle of rays, and the remainder are dissipated uselessly inside the lamphouse.

A reflector is usually provided behind the lamp to collect a proportion of this waste, but still leaves unused the greater part of the light emitted by the filament. The shutter allows only about 50% of the light to pass, as the shift and anti-flicker segments cut off the light for approximately half of the time.

Turning to the film, here probably 50% is absorbed, even with a good print of normal density. With an overprinted or a dirty copy the loss at this point may be much more than the 50%.

The next appreciable loss is at the screen, the amount of this loss depending on several factors, such as the surface, the condition of the screen, the alignment of the projector beam, and the viewing angle.

There are further minor losses, but if only major losses are considered it will be seen that the sub-standard projector is by no means an efficient instrument.

The efficiency of the tungsten filament lamp is not considered in these calculations as there are enough losses to deal with apart from this. However, it is of interest to know that something less than one-tenth of the energy applied to a lamp is returned in the form of light. These losses can be separated into groups as follows :

(1) Electrical ...	...	...	...	...	Approximately 50% loss
(2) Mechanical ...	...	...	...	...	50% "
(3) Optical ...	...	...	...	...	90% "
(4) Photographic ...	...	...	...	...	50% "
(5) Screen ...	...	...	...	...	50% "

thus leaving only about half of one per cent of the light to reach the eyes of the audience.

If each of these groups is analysed, it is found that in the case of some

*Kodak, Ltd. (Medical Dept.)

losses nothing can be done, whilst with others an improvement might be effected. Let the losses that have an electrical origin be considered first.

Losses of Electrical Origin

The first 16 mm. projector, the Model "A" Kodascope, was fitted with a 56 watt lamp, operating on 14 volts. With later models, when higher wattage lamps were made to operate in the 100—125 volt range, it became standard practice to use mains-voltage lamps in the United States, where the supply service is generally between 100 and 125 volts. This practice was followed in Europe, and projectors were designed for a 100 volt input, making the use of a supplementary resistance or a transformer necessary when coupled to the usual 200/250 volt mains found in this country.

The adoption of 100 volts was perhaps unfortunate, as there is some advantage to be gained by the use of a lamp designed for low voltage operation, because this will have a relatively thick filament and a small filament area,

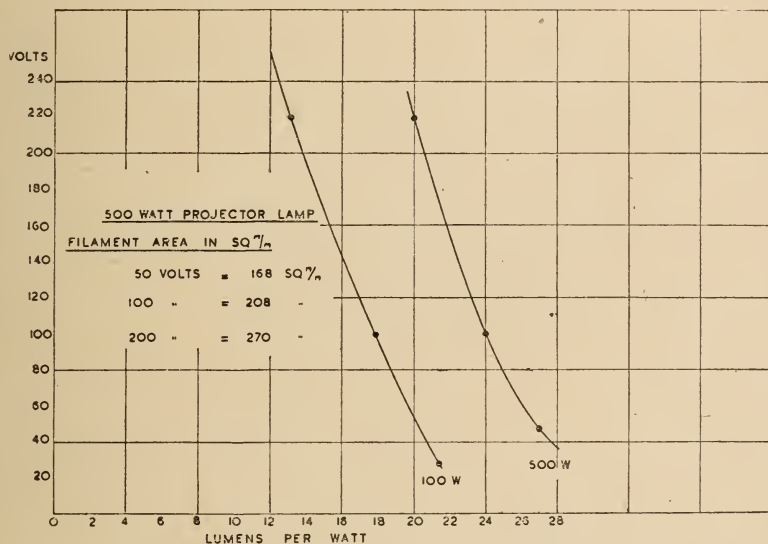


Fig. 1. Efficiency of Projection Lamps of Different Voltages.

which will provide a higher light output per watt. Fig. 1 illustrates this, the filament area and light emission being related to the voltage of the lamp.

It can be seen that an improvement in light emission results from the use of lamps designed for low voltage operation. A greater use of low voltage lamps in sub-standard projectors might be expected, but so far manufacturers seem disposed to retain the 100/125 volt lamp. Conditions favour the use of low voltage lamps in this country, as over 80% of British houses have A.C. supply.

Alteration of Voltage

At this point it is convenient to consider the effect of altering the voltage applied to a projector lamp.

Undervolting results in a more than proportional loss of light, and the curve in Fig. 2 will show how the light output changes with differences in voltage. Closely related to this is the question of lamp life, and this point also is illustrated in Fig. 2.

The life of a projection lamp is of some importance to the user. It is instructive to calculate the lamp cost per hour, based on the lamp price divided by the makers' rated life in hours. The following table shows the lamp cost per hour for 100 watt, 300 watt and 750 watt lamps.

COST OF PROJECTION LAMPS

Wattage	Lamp Replacement Cost per Hour	Lamp Replacement Cost per 2,000 Lumen/Hours
100	2.8 pence	3.5 pence
300	6.2 pence	2 pence
750	9.3 pence	1 penny

The author has found that makers' estimates of lamp life are usually on the low side, and in practice these highly stressed projector lamps stand up to their job remarkably well. Lamp costs, however, are a factor in sub-standard projection costs.

It will be seen that the lamp cost per hour increases rapidly as the wattage increases, but when a light output factor is introduced it is found that the cost per lumen hour is steadily reduced with lamps of higher wattage.

These figures, however, relate to the lamp outside the lamphouse. When the lamp is placed in the projector, the high wattage lamp fails to show a proportional increase of light compared with the lamp of lower wattage.

Optical Efficiency

The optical efficiency of the average projector can now be considered. The amount of light collected by the condenser is only a small portion of the total emission from the filament. It is reasonable to assume that little more than 10% of the total light is picked up by the condenser system, and even after allowance is made for the slight addition which can be expected if the mirror behind the lamp is in good condition and accurately adjusted, there is still a considerable loss to be faced.

In lamphouse design we have advanced only a little from the days of the magic lantern with its multiple wick oil lamp. We no longer suffer from the smell that was characteristic of an old time "magic lantern" display, but as much light as ever is still wasted inside the lamphouse.

There have been attempts to increase the light entering the condenser by placing the lamp filament a little in front of the mid position of the bulb, but the offset filament is not a general feature of projection lamps.

The use of a reflector behind the lamp is normal practice, and this reflector is expected to return some of the light emitted from the back of the filament. This may happen in some cases, but it is the author's opinion that the reflector has generally lost its reflecting power, or if any remains, the fitting is so badly adjusted as to be useless.

In practice it is very difficult to adjust a lamphouse reflector accurately, as it is far too hot to handle and the glare makes it hard to see the effect of any adjustment.

The aperture of the projecting lens affects the light on the screen, and with a lamp and condenser properly adjusted to the projection lens a large lens aperture will provide better screen illumination. This improvement, how-

ever, is not entirely a function of the lens aperture, as it is in the case of a camera lens, but depends also on whether the condenser system is designed and adjusted to make full use of the large aperture.

The effect on screen illumination due to the use of anti-reflection coated lenses is twofold : first, an increase in the light transmission, and second, an improvement in the contrast of the projected image. The light loss at each glass-air surface depends on the type of glass used, but if we take an average figure of 5% loss at each surface it can be seen that appreciable loss occurs in the optical system of a projector which includes ten or twelve lens surfaces. The effect of coating is to reduce this loss to about half. The improvement in efficiency due to coating on a 16 mm. silent projector of postwar design is an increase of about one third in the light on the screen.

Mechanical Efficiency

The major loss due to a mechanical cause is the cutting off of the light by

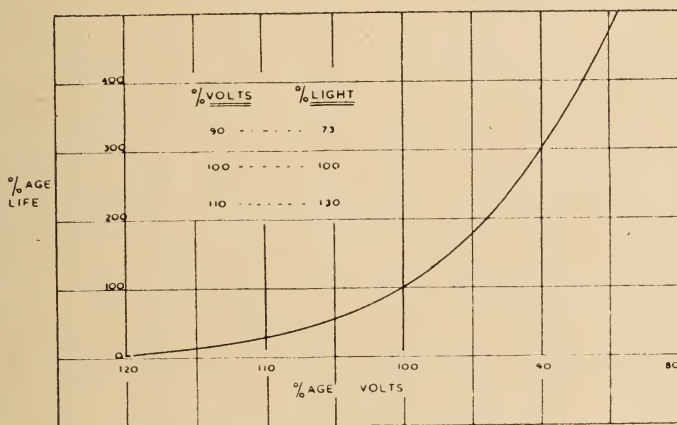


Fig. 2. Effect of Actual Voltage upon Lamp Life.

the shutter whilst the film shifts to the succeeding frame. This can be modified by increasing the speed of the film shift, but mechanical factors limit this, as well as the ability of the film to stand up to greater acceleration without damage.

Usually two anti-flicker blades are provided, and the effect of these, added to that of the blade which obscures the light for the film shift, is to allow only about half of the light to pass the shutter.

Some shutter designs are more efficient than others, and a slight improvement results from the use of a large diameter shutter. Contra-revolving shutters can also help to a small extent.

The shutter can be placed at any point in the light beam. The position in front of the lens is seldom used in sub-standard projectors, and the general practice is to place the shutter between the light source and the film, in which position it reduces heat on the film from the light beam.

Screen Efficiency

The reflective value of the screen surface has a considerable effect, and this can vary from the 80% reflected by the most efficient screens in new condition, down to the poor reflectivity of a flat white surface in dirty condition.

It must not be forgotten that the angle of the screen in relation to the axis of the projector and the centre of the audience can affect the brightness of the picture. This effect is most noticeable with high efficiency screen surfaces, such as bead and silver, and diminishes with the flat white screen.

Figs. 3 and 4 represent two typical projection conditions, the screen being of the silvered type. In Fig. 3 the projector is mounted slightly above the heads of the patrons, and the reflected beam, it will be observed, has its greatest intensity towards the ceiling.

Fig. 4 shows projection from a balcony, with a screen at right angles to the projector beam. A slight tilt of the screen in the direction of the audience would improve matters in each of these examples. When working under difficult conditions it is worth spending a little time in adjusting the tilt of the screen so that the central ray of the projector beam is reflected to a point in the centre of the audience. A small pocket mirror can be laid on the centre of the screen to aid in obtaining the correct degree of tilt.

The beaded surface, however, has a reversed reflectivity characteristic, in that the most intense reflection is always in the direction of the light source,



Fig. 3. Effect of Upward Projection Rake with Silver Screen.

no matter what the angle at which the beam impinges on the screen. Tilting the screen has thus little or no effect upon optimum viewing position.

Other conditions that affect the brightness of the screen image are stray light in the hall, and fog or tobacco smoke. Stray light must be kept away from the screen and also from the eyes of the audience.

Fog or smoke between the projector and screen degrades the screen image, and this is the result of several factors. The first effect of fog is to reduce the light reaching the screen, and then further to reduce the light reaching the eyes of the audience, from the screen. The second effect is to scatter the light from the projector beam, and most of this scattered light reaches the audience, the adaptation of whose eyes is modified by the glare.

The effect of fog or smoke can be very serious, and it may be the basis of the generalisation that the longer the throw the greater the light required. This is not strictly accurate, as with air relatively free from mist or dust particles the effect of an increased projection distance is not worth considering when using comparable optical systems.

Future Possibilities

If it were possible to make more effective use of the light source by a radical

change in design of lamphouse, the extra cost would probably be more than offset by the improved performance of the projector.

This opens up the possibility of a "Sealed Beam" unit for sub-standard projectors. This might follow current automobile head-lamp practice and provide a factory-adjusted unit comprising light source, reflectors and condenser.

It is unlikely that a sealed beam system would be an economic proposition at present. If therefore the present layout of lamp, condenser, and reflector is to continue, why cannot prefocused reflectors, to use in conjunction with prefocus lamps, be available? Why cannot a prefocus lamp be so accurately set as to make any independent adjustment of its position quite unnecessary?

The loss of light at the shutter could be reduced if a light source in a small area were available, with similar characteristics to those of the "Kodatron" Speedlamp, in which a condenser discharge produces a short intense flash. Flashes could be timed to give dark intervals for film shift and anti-flicker.

Another system that the future may bring is a condenser discharge source

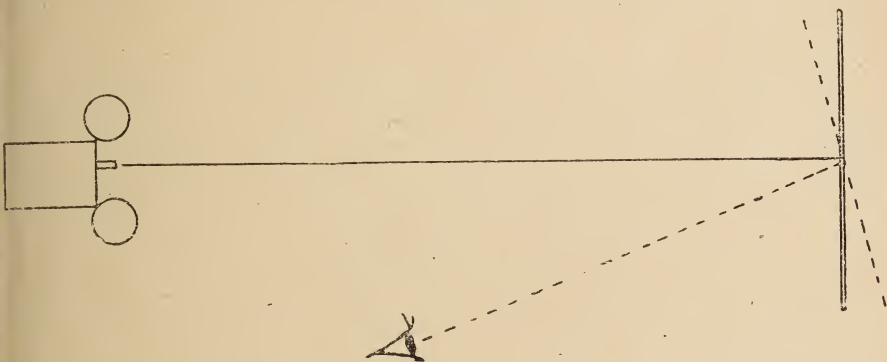


Fig. 4. Effect of Level Projection with Silver Screen.

in conjunction with a continuously moving film. A flash time of one ten-thousandth of a second would limit the displacement of a continuously running 16 mm. film to less than two-thousandths of an inch. A luminescent screen with an afterglow would be needed, and a decay rate long enough to permit overlapping of succeeding images might improve flicker characteristic. The combination of "human visual persistence" with "screen image persistence" provides an interesting field for research.

Whilst on the subject of the lamphouse, sub-standard lamps may be considered.

Sub-standard Lamps

Is it in our interests to have nearly forty different lamps to choose from? Do we really want all the types of lamp cap at present in use? Is it really necessary to have projector lamps in such a variety of voltages and must we have as many as ten wattage ratings available? The B.S.I. have considered these problems and as a result some action is likely to be taken to alter what is really an absurd and quite uneconomic state of affairs.

Speaking with some knowledge of projecting conditions the author is

convinced that only three wattage ratings are needed, and these are :

- (1) 200 watts for use in the house.
- (2) 400 watts for use in the classroom and laboratory.
- (3) 750 watts for use in small halls.

A decision as to the most efficient operating voltage, *i.e.*, whether it is to be low (20—50 volts), medium (100—125 volts), or mains voltage (200—250 volts), can only be arrived at after an investigation of all the problems involved, and this investigation should be a joint effort of the lamp maker, the designer of the optical system, and the mechanical engineer.

As the findings of these specialist investigators will probably be of greater value to the user than to the manufacturer, this seems to be an opportunity for the British Kinematograph Society to take the initiative and refer the problem to a few specialist members of the Society who would be able to provide some authoritative information on a matter of great interest to all users of projectors.

It is of course possible that some new light source is well on the way, and in this case the specialists can be expected to know of it and make the necessary allowances in their report.

Print Density

Next comes the question of print density. This is too big a subject for adequate coverage in this paper, but it might be worth while to consider one of the less obvious possibilities.

In the classroom, for example, there is a need for a really portable projector, therefore it must be as small and as light as possible, and there is also a need for economy, for the running costs must be kept low. The modification of only one feature—a reduction of lamp wattage—can help us to meet both of these needs. Before this can be done, however, steps must be taken to adopt an average print density for educational films that will suit classroom conditions.

The conditions that existed years ago when the fixed projector was fitted with an arc lamp which could cope with the density of most prints, whilst the portable outfits which visited the Town Halls and Corn Exchanges had to make do with the oxy-hydrogen lamp, are once more evident. Portable projectors were enabled to function by the laboratories providing on request a low density print—called a “limelight print”—for use with oxy-hydrogen illumination. The provision of similar low-density prints for classroom use would, in the author's view, do much to encourage the use of motion pictures in the classroom.

Earlier in this paper mention was made of the degrading effect of fog or smoke. Little improvement is obtained by increasing the light, as it still fails effectively to penetrate the smoke, and only adds to the scattered light and glare. The only useful effort that can be made in these circumstances is to increase the ventilation. In some cases a fan close to the projector to disperse the smoke laden air through which the concentrated light beam has to pass will be more effective than an increase in the lamp wattage.

In conclusion, I should like to acknowledge the kindness of those who have provided me with information, in particular Mr. A. G. Penny, whose knowledge of the filament lamp has been of the greatest help.

DISCUSSION

Mr. W. HUMBERSTONE : Regarding the changing of a projector lamp during the show, strictly speaking this should not be necessary, as usually a lamp gives signs of impending failure. If one looks at the filament of an old lamp, one can see

bright spots which give an indication that at any time it may fail.

Mr. PEELER : One method of focusing the lamp is to operate it at a lower voltage ; you can then focus the dull red image without burning your hands.

Mr. A. G. PENNY : Regarding reflector adjustment, the lamp filament is positioned in relation to the cap to within $\pm \frac{1}{2}$ mm., so you can be certain that in actual fact it is within $\pm \frac{1}{2}$ mm., and that is quite sufficient for any commercial type of mirror.

The B.S.I. is in the process of producing a schedule of projector lamps. The schedule will cut down from 130 to about 30 of the types of substandard projector lamps. To cut the number of different types down to 20 or 30 is merely nibbling. If you could cut the types down to three or four, there would be some prospect of getting standardisation which is desirable.

Mr. ROUND : I have recently been trying a lamp operating on 24v., and having an internal mirror surface. Carrying out tests in accordance with the B.S.I. standard, I found I was able to increase the light efficiency on the screen by something like 10%.

Mr. GREENHILL : Has any work been done to determine what is considered to be a comfortable level for viewing the screen for sub-standard work? Also, is any relatively easy method of measuring screen brightness available?

THE AUTHOR : There is a method, set out in B.S.S.930.

Mr. R. H. CRICKS : Surely the most efficient filament lamp yet seen is the Philips 15v. lamp, carrying either 20 or 30 amps. In my view a screw cap is quite unsuitable for this high current. The only cap that will carry such a current is the bi-post ; it might be more expensive, but it should be adopted.

I am sorry to disappoint Mr. Buckstone on the matter of the continuous projector, and the possibility of increased light. In most machines of this type, it is necessary for the light spot to cover two frames of film, resulting in wastage of light.

Mr. N. LEEVERS : On the question of source size, there is a big difference between lamps rated at 200/240v., the 110v. range, and the ranges up to 50v. In general, the source shape of the high voltage lamp is not so compact. The 110v. range is much more compact, and in some sizes consists of overlapping coils. When you come down to very low voltages, the separate filament coils are actually touching one another, and you can achieve remarkably compact light sources.

BOOK REVIEWS

THE HISTORY OF THE BRITISH FILM : 1896—1906. By Rachael Low and Roger Manvell. (George Allen and Unwin, Ltd., 136 pages, illustrated. 21s.)

There are classic reference books for various art forms, for industries and even for hobbies. Kinematography has its periodicals, its specialised technical books and its biographies, but has hitherto lacked a serious record of its progress from the penny gaff to the super-kinema, from histrionics in the back-yard to the hushed magnificence of the modern studio. Lewis Wright wrote the classic reference book of the optical lantern, in addition to a monumental work on poultry. Kinematograph studio technique was dealt with in a valuable opus of that title in 1922 by L. C. Macbean, and still the best book of its kind, though naturally dated. And now, at long last, we have a splendid factual report of the development of film production in Great Britain.

Accurate accounts are given of earliest methods, as well as details of actual production titles and stories, and the glimpses of the first British studios are of particular interest. An industry which has grown in such a short time from a humble place in the travelling fairs to its present colossal dimensions deserves something better than the inaccurate "romance of the movies" type of literature which has appeared from

time to time—and now it has arrived.

It is a very well produced volume, excellently illustrated, and I am now looking forward to the volumes covering the later periods, 1906 to 1914, and 1914 to 1928. This is a book which all British studio technicians should read and keep for reference.

BAYNHAM HONRI.

SYMPOSIUM ON SEARCHLIGHTS, (Illuminating Engineering Society, 18s. 6d.)

This book consists of a series of five papers read to the Illuminating Engineering Society on April 15 last. The ensuing discussions are also printed. Two or three of the papers are of interest to those engaged in the kinematograph industry.

Heavy Current Searchlights. This paper outlines the design of these lamps, which is based on the current density normally used in kinema projection. The principal positive carbons used were 37 mm. at 1,400 amps., and 64 mm. at 4,000 amps.

The Leigh Light is described in detail, and its adaptation to war needs for use in aircraft is discussed. Projectionists who have had trouble with draughts inside the lamphouse will appreciate the achievement in ventilating an arc lamp moving through the air at about 200 miles per hour. The arc lamp used was a slight modification of the standard searchlight, the mechanism of which is illustrated,

LIGHT AND COLOUR IN STAGE PRESENTATION

P. Corry*

Summary of paper read to the B.K.S. Manchester Section on January 6, 1948

STAGE lighting, in common with all types of lighting, has two fundamental principles: utilitarian and aesthetic. In stage shows, pointed out Mr. Corry, the latter has to be expressed more than the former; the grotesque and fantastic must be deliberate and not accidental.

Mr. Corry then said that all stage lighting equipment could be roughly divided into two groups. These were the flood group, which dispersed light over a wide area, and the spot group, which concentrated a beam of light. Both of these groups had to be used in planning stage light.

In planning stage light a diffusion of light is required, and there must also be sufficient directional light to cover the whole of the stage. The author gave a method for determining the number of spotlights required for a stage. This was done by dividing the stage into four or eight parts, according to its size, and then allowing for two spots to be concentrated on to each of the squares, from opposite directions; this gave complete control of lighting over the whole area. The author stated that the distribution of light over the various squares made variation from one square to another quite possible.

The author mentioned that a stage flood-light with a reflector should give three times the intensity available than if it had none. The difference between floods and spots was explained in the variation and flexibility of the beam angle.

Three-dimensional Lighting

Differences in stage technique between today and the early days were examined. In the early days a blaze of flat light was the only illumination available. Shades and highlights had to be painted on to the scenery, and consequently the actor had to be heavily made up. To-day, Mr. Corry explained, the third dimension has been emphasised, by means of directional lighting.

The necessity for a close control of the intensity of light was emphasised. Every circuit should, declared the speaker, be controlled through a dimmer. The merits of the various types of dimmers were discussed. Remote control was being given more prominence than ever before. The advantage of this, according to the author, was that it gave great concentration. The number of circuits might vary from 90 to 150 ways. Another advantage was that it dispensed with the unwieldy size of a directly operated switchboard.

When the three primaries, red, green, and blue, were mixed, hundreds of different tints were obtained. A mistaken assumption was that placing a colour medium in front of a light added colour to the beam; colour was not added, but subtracted, therefore, stated the author, a greater intensity of light had to be used when dealing with colour. Sixty different colour filters were provided, so that colour effects could be obtained without wasting the intensity.

Mr. Corry finished his paper by giving a short résumé of typical stage equipment. It was explained that the amount and disposal of equipment varied considerably according to the type of theatre and that the permanent equipment installed was usually augmented by additions of acting area lanterns, spots, floods, etc., brought in by visiting companies. A typical

*Strand Electric Co., Ltd.

permanent equipment for a provincial theatre was suggested as being :—

- | | | | |
|------------------------------|--|-----|--|
| 1. PROJECTION BOX | ... | ... | 2 or 3 arc lamps, used generally for spotting artists. |
| 2. FRONT OF HOUSE LIGHTING | ... | 6 | or 12 1,000w. Mirror Spots situated at the front of the circle or balcony. |
| 3. FOOTLIGHTS | ... | ... | In 3 or 4 circuits. |
| 4. BATTENS | ... | ... | In 3 or 4 circuits situated at about 7ft. centres above the stage. 4, 5 or 6 battens are likely to be used. |
| 5. SPOT BAR | ... | ... | Usually situated immediately inside proscenium arch with accommodation for 12 or 18 1,000w. Spots for giving directional light on the acting area. |
| 6. PORTABLE FLOODS AND SPOTS | May be used in various positions on the stage. Usually connected to stage plugs (or dips). | | |
| 7. SWITCHBOARD | ... | ... | A permanent switchboard should control all the permanently installed equipment. A special plug is provided to supply the portable switchboards required to control the additional equipment carried by the visiting company. |

During the paper, demonstrations were given of effects lighting, Samiloff lighting, and of ultra-violet radiation on Celanese fluorescent materials.

DISCUSSION

A MEMBER : Is the carbon arc no longer used for floods, spots, etc.?

THE AUTHOR : The use of carbon arcs is almost entirely restricted to spotting arcs. Each arc requires an individual operator and is, therefore, generally superseded for spots and floods in which incandescent lamps are more satisfactory and more easily controlled.

A MEMBER : You made remarks on the subject of spotting actors.

THE AUTHOR : For anything dependent

on individual expression, I think the spotting arc most necessary.

A VISITOR : You stated that for colour mixing green can sometimes be omitted. What should one use instead?

THE AUTHOR : A primary green involves a loss of intensity and for many colour mixtures it is preferable to use blue-green which allows a higher intensity of light to pass. For many colour mixtures it has been found preferable to use orange, primary blue and blue-green in preference to the primary red, green, and blue.

B.S.I. DRAFTS FOR COMMENT

Among draft specifications circulated by the British Standards Institution for comment are the following :

CJ(CME)6756.—*Draft British Standard for Lenses for 35 mm. Kinematograph Projectors.* Part 1 of this draft specifies essential dimensions for five types of projection lenses, as follows :

Type 1.—1.673 in. diameter.

Type 2.—2.062 in. diameter.

Type 3.—Stepped mount with fitting diameter of 2.781 (three models).

Type 4.—Thread mounting, 2½ in. diameter.

Type 5.—Thread mounting, 3 in. diameter.

Type 6.—Thread mounting, 3½ in. diameter.

The specification of Type 6, which permits of a range of lenses working at $f/1.4$, is intended as a basis for future design.

Part 2 of the draft defines the parts of a projection lens and the important quantities involved, and specifies methods and accuracy of marking focal length and aperture, together with methods of measurement.

Draft Sub-code 327.201.—*Broadcast Reception : Sound and Television by Radio.* This draft brochure contains many details necessary for the correct installation of radio and television receivers in all types of buildings. The need for planning an installation in advance is emphasised. Several types of aerials are described, and there is useful information on suitable wiring systems.

TECHNICAL ABSTRACTS

Most of the periodicals here abstracted may be seen in the Society's Library

THE ANATOMY OF NITROCELLULOSE FILM.

R. A. Mitchell, *International Projectionist*, Feb., 1948, p. 5.

Valuable data on the subject of the composition and combustibility of nitrate film show that the gases given off in decomposition are highly inflammable, and are the cause of so-called celluloid explosions. The effect of the emulsion is to slow down combustion, to leave a black ash, and give off deleterious fumes. R. H. C.

NEW PHOTOGRAPHIC METHOD.

Dippel and Kouning, *Philips Tech. Rev.*, No. 9, 1947, abstracted in *Funk und Ton*, March, 1948.

A film carrier, for example of Cellophane, is dipped into a bath containing a diazo compound and an additional mercury compound, both soluble in water. When exposed, the diazo compound is decomposed and leaves a latent image of mercury on the carrier. The carrier is then subjected to a physical development process and the latent image of mercury is replaced by silver. As the carrier when sensitised in this manner does not possess any grain, a very high resolution and definition is obtained.

The gamma can be controlled between very wide limits (from 1 to 8), and independently for sound and picture, and it is claimed that a very high quality of picture and sound can be obtained. O. K. K.

THE DRYING LAMP AND ITS MOST IMPORTANT APPLICATIONS.

Th. J. J. A. Manders, *Philips Tech. Rev.*, Vol. 9, No. 8.

The raising of the temperature to assist the evaporation of water is most efficiently performed by the use of radiant heat, which is absorbed in the body of the wet layer. The design and performance of a lamp, which gives the best compromise between the absorption and penetration, is described, together with various industrial applications. (The lamp would appear to have applications in the drying of kinematograph film. Abs. note) M. V. H.

AN IMPROVED INTERMODULATION MEASURING SYSTEM.

G. W. Read and R. R. Scoville, *J. Soc. Mot. Pic. Eng.*, Feb., 1948, p. 162.

Intended primarily for the measurement of distortion in variable density recording, the system consists of two units, the signal generator and the intermodulation analyser. In the former, two R.C. tuned oscillators producing the low and high frequency tones are each adjustable to give a choice of four spot frequencies by means of selector switches, and the ratio of levels in the mixed output is also adjustable by switching. Mixing is by means of a hybrid coil.

The analyser contains the filters necessary for elimination of the low frequency component, and for integrating the rectified high-frequency component. The distortion or envelope is measured by a valve voltmeter. A phase detector is arranged to indicate on which half-cycle maximum compression of the signal is occurring. N. L.

NEW DEVELOPMENTS IN MERCURY LAMPS FOR STUDIO LIGHTING.

F. E. Carbon, *J. Soc. Mot. Pic. Eng.*, Feb., 1948, p. 122.

The results of extensive development work in England on high pressure mercury vapour lamps for motion picture and television studio lighting are described. The lamps consist of heavy tungsten electrodes mounted inside a quartz bulb containing a small amount of mercury and cadmium or zinc. An arc of high brightness forms between the tungsten electrodes and constitutes a suitable source for use with the optical systems normally employed in studio lighting fittings. Its efficiency is initially between 45 and 55 lumens/watt, and falls by about 25% during life, and the cadmium and/or zinc produces sufficient red light to make the colour rendering properties of the light suitable for use with colour film processes.

The advantages of these lamps are high efficiency, low heat radiation, long life, silent operation, and cleanliness. Their disadvantages are slow initial start and difficulty of restart when hot, the possibility of bursting of the quartz bulb, and higher cost. F. S. H.

THE COUNCIL

Meeting of July 7th, 1948

Present : Messrs. A. W. Watkins (*Vice-President*), F. G. Gunn, A. G. D. West, Rex B. Hartley, C. H. Champion, I. D. Wratten (*Past President*), P. H. Bastie (*Hon. Treasurer*), B. Honri, R. E. Pulman (*representing Theatre Division*), H. S. Hind (*representing Sub-Standard Division*), R. H. Cricks (*Secretary*), and W. L. Bevir (*Acting Secretary*).

Home Office Regulations.—It was reported that recommendations concerning Home Office regulations had been finalised.

Patron Membership.—An *ad hoc* Committee was appointed to study the position of Patron Membership.

Premises.—Proposals for the provision of premises were considered.

Film Mutilation Brochure.—Specimen material had been circulated to certain C.E.A. members for consideration of style and subject matter.

Papers Committee.—It was reported that the 1948/49 lecture programme would probably be finalised before the next meeting.

Joint Meeting with A.C.T.—It was agreed to hold 5 joint meetings in the coming session.

Social Committee.—It was proposed to arrange a dinner during the forthcoming session.

Branches Committee.—It had been decided to prepare Standing Orders for Branches and Sections in order to control expenditure. The lecture programme for the three Sections was in hand.

Theatre Division.—The question of appointing an Hon. Secretary had been deferred till the next meeting of the Committee.

Sub-Standard Division.—The lecture programme was reported to be well in hand.

Film Production Division.—It was urged that an account of the visit to M.G.M. Studios should appear in an early issue of the Journal.

Library Committee.—A letter was read from Mr. Hartley tendering his resignation as Chairman of the Committee from September 30th.

Use of Committee Room.—A vote of thanks was conveyed to the C.E.A. and Mr. Knopp for use of the Committee room.

EXECUTIVE COMMITTEE

Meeting of July 7th, 1948

Present : Messrs. A. W. Watkins (*Vice-President*), L. Knopp (*Deputy Vice-President*), P. H. Bastie (*Hon. Treasurer*), I. D. Wratten (*Past President*), W. L. Bevir (*Acting Secretary*) and Miss S. M. Barlow (*Assistant Secretary*).

Elections.—The following were elected :—

JOHN WILLIAM CLARK (Associate), Princes Theatre, Leicester.

WALTER PERCY DAY (Member), Alexander Korda Film Productions, Ltd.

CHANDRA SEKHAR SINGH (Student), Nettlefold Studios, Ltd.

PAUL LEOPOLD PULVER (Member), Pulver & Co., Ltd.

STANLEY GEORGE OTWAY CHARMAN (Associate), RCA Photophone, Ltd.

ALEXANDER FRASER (Member), Odeon Theatre, Motherwell.

PETER R. MUSGRAVE (Student), Mercia Film Productions, Ltd.

CYRIL B. FAULCONBRIDGE (Member), British Lion Studios, Ltd.

JOHN ALFRED JOSEPH BRIGGS (Member), British Films, Ltd.

NED HERBERT MANN (Member), London Film Productions, Ltd.

GERALD FRANCIS GASK (Member), British Instructional Films, Ltd.

GEOFFREY HOLMES GLENNY (Associate), British Films, Ltd.

WILLIAM EDWARD McCONVILLE (Associate), Pathé Pictures, Ltd.

HERBERT FREDERICK ARTHUR HAMMOND (Member), British Instructional Films, Ltd.

Transfers.—The undermentioned Associates were transferred to Members :—

WILLIAM ARTHUR PERCY QUINN, D. & P. Studios, Ltd.

FREDERICK HENSHALL SMETHURST, London Electricity Board, Northern Sub-Area.

Death.—The following death was noted with regret :—J. W. CAMPBELL.

Resignation.—The following resignation was accepted with regret :—PETER RIGDEN.

LECTURE PROGRAMME

September, 1948

The lecture programme for the Autumn, 1948, session will be published next month. The following meetings will be held during September :

- Sun., Sept. 19 11 a.m. **"Coloured and Directional Lighting as applied to the Stage,"** by L. G. APPLEBEE, F.I.E.S. To be preceded by a film, "Fighting Film Fires," by courtesy of the Admiralty Film Unit. (Theatre Division.)
- Wed., Sept. 22 7.15 p.m. **"Methods of Film Direction,"** by ALFRED HITCHCOCK, (Joint meeting with A.C.T.)

The above meetings will be held in the G.B. Theatre, Film House, Wardour Street, W.1. Light refreshments will be served prior to the papers.

NEWCASTLE-ON-TYNE SECTION

- Tues., Sept. 7 10.30 a.m. **"Carbon Brushes for Electrical Machines,"** by W. D. HARRISON. Meeting to be held in the Newe Theatre, Pilgrim Street.

THE SECRETARYSHIP



As a result of the increasing membership of the British Kinematograph Society, and the ever-widening scope of its activities, the Council has decided to divide the administrative and technical aspects of its organisation.

It has accordingly appointed Mr. W. L. Bevir as Secretary. He will be responsible on a full-time basis for the administration of the Society.

Mr. Bevir has a wide knowledge of the film industry, having been for over ten years with Twentieth Century-Fox Films and British Movietonews, prior to which he had some legal experience.

Mr. R. Howard Cricks, F.B.K.S., F.R.P.S., who in 1938 was appointed Organising Secretary, and on the incorporation of the Society in 1946 became Secretary, will continue to edit the Society's journal, *British Kinematography*, and also act as Technical Consultant to the Society. He will, however,

remain free to undertake other technical work on a free-lance basis.

Miss S. M. Barlow, Assistant Secretary, will continue to handle the business side of the Journal.

THE LIBRARY

Among recent accessions to the Library is a valuable encyclopaedia of photography, generously presented by Messrs. Ilford, Ltd. Entitled *THE COMPLETE PHOTOGRAPHER*, it comprises nine volumes, and covers the whole field of photography, both as an art and a science.

Other accessions include: *BROADCAST OPERATORS' HANDBOOK*, *GLOSSARY OF*

PHYSICS, *TEMPERATURE CONTROL*, and *PRACTICAL ELECTRIC WIRING AND CONTRACTING* (presented by Mr. G. Parr); *TWENTY-FIVE YEARS OF FILMS* (presented by Mr. L. Knopp); *MOTION PICTURE SOUND ENGINEERING* (presented by Mr. W. M. Harcourt); and *THE ART OF THE FILM* (presented by the publishers, Messrs. George Allen & Unwin, Ltd.).

PERSONAL NEWS of MEMBERS

Members are urged to keep their fellow members conversant with their activities through the medium of *British Kinematography*.

Dr. HANS KUHN is visiting Germany and later France, where he is to study production technique; he anticipates making a medical film in Paris.

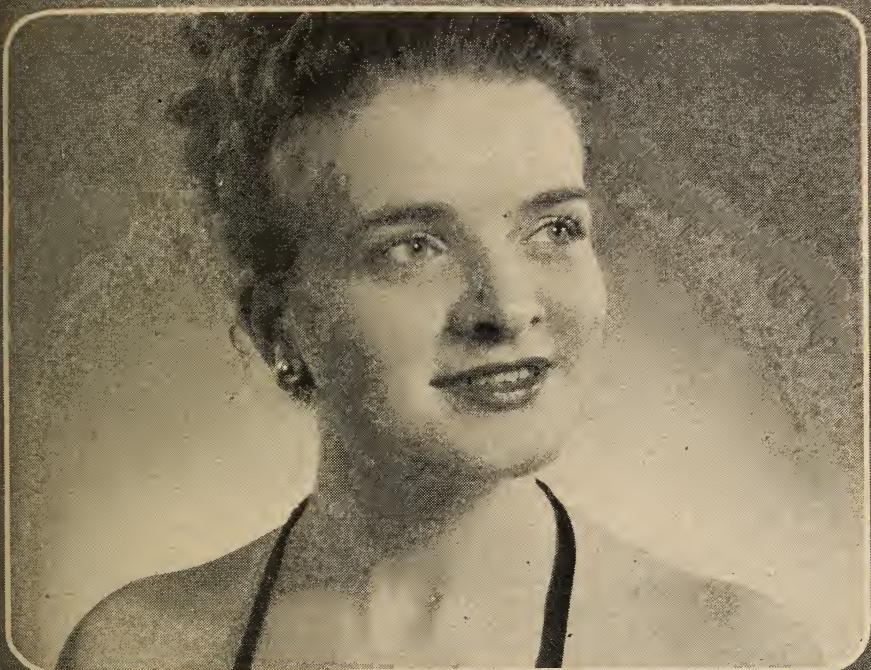
T. B. THORESEN has now returned to Norway after concluding the two-year course at the Polytechnic.

K. C. WILES has returned from Vancouver,

where he reports that anticipated film production projects have not been realised.

PERSONAL ANNOUNCEMENTS

Small announcements will be accepted from Members and Associates. Rate, 4d. per word, plus 2s. for Box No. if required (except for Situations Wanted). Trade advertisements, other than Situations Vacant, not accepted.



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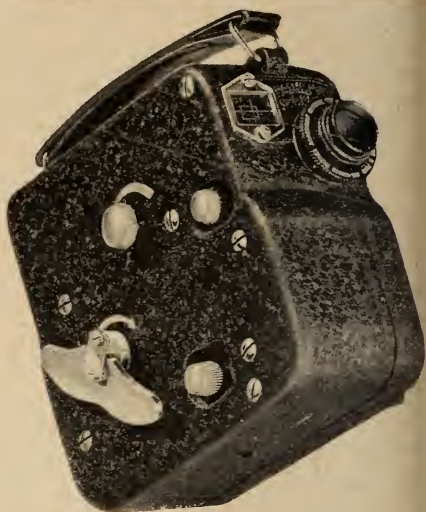
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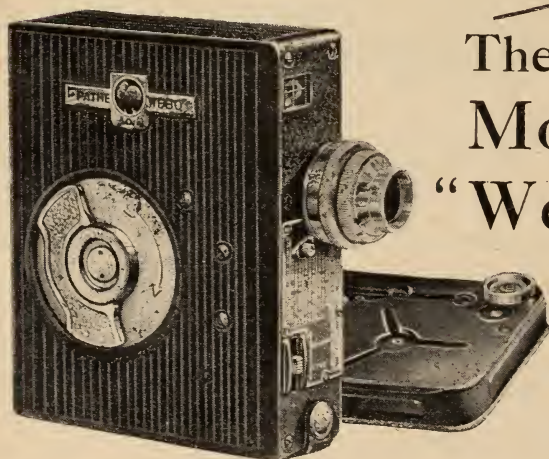
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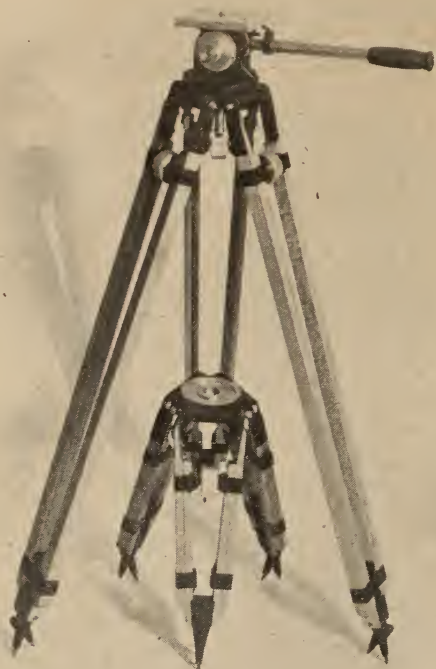
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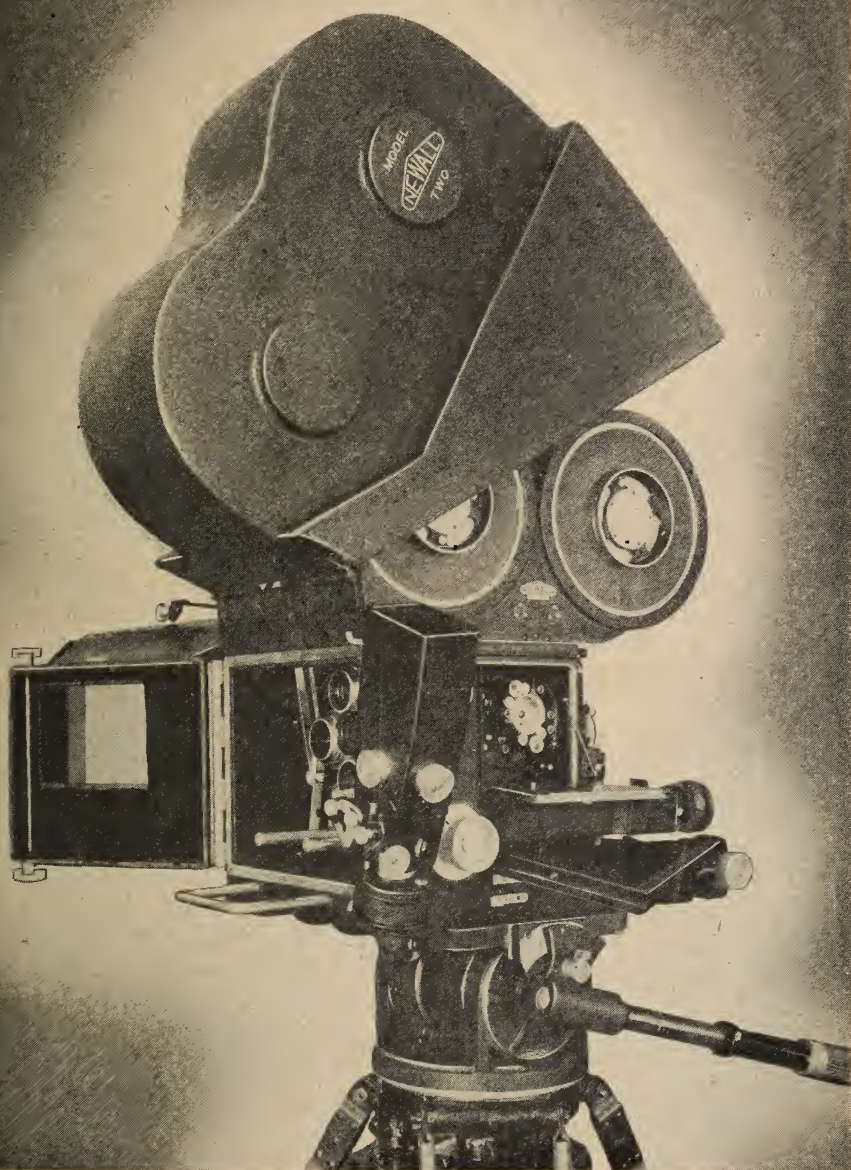
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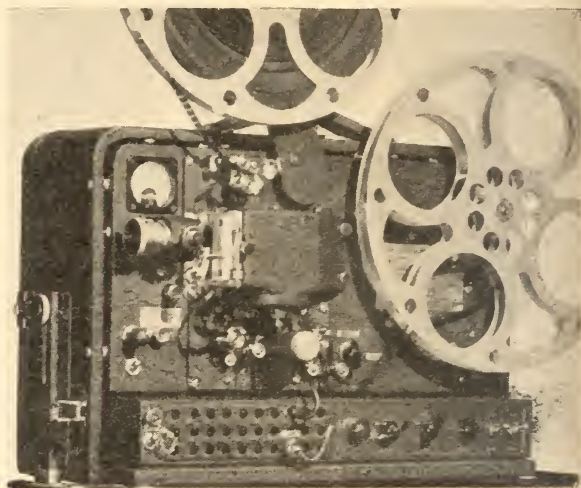
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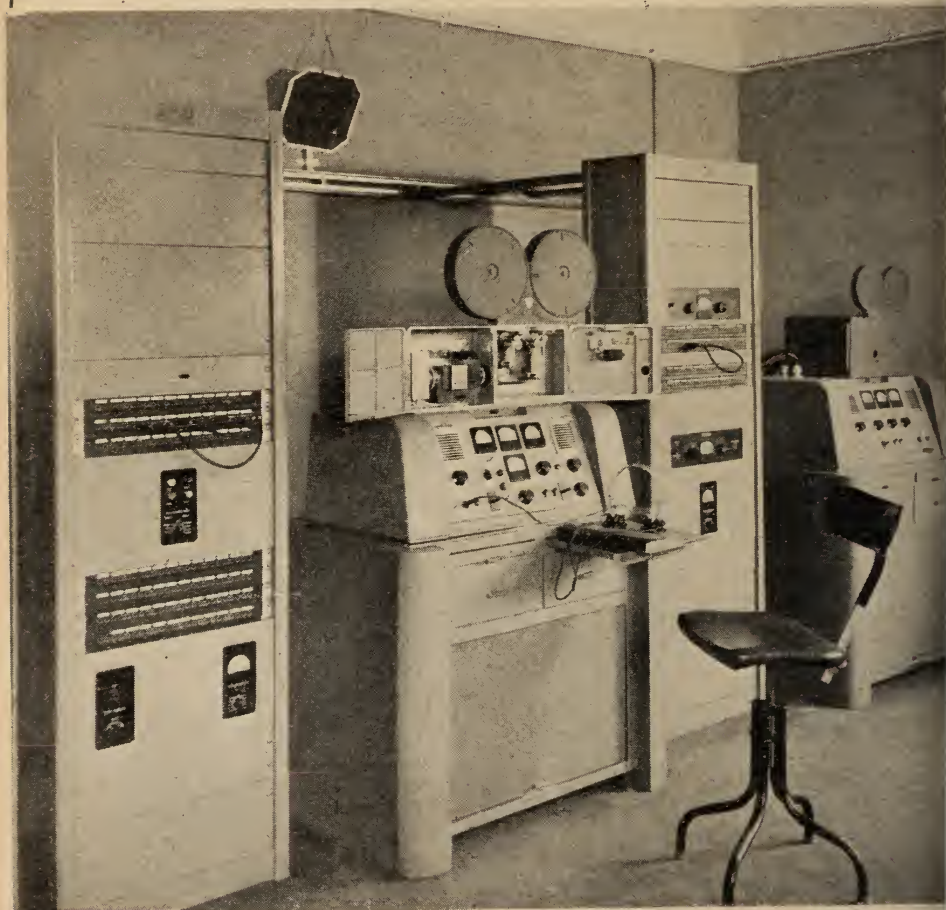
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The Journal of the British Kinematograph Society

VOLUME THIRTEEN, No. 3.

SEPTEMBER, 1948

LECTURE PROGRAMME—AUTUMN, 1948

Meetings to be held at the Gaumont-British Theatre, Film House, Wardour Street, London, W.1, commencing at 7.15 p.m., Sundays, 11 a.m. Sub-Standard meetings in the G.-B. Small Theatre.

SOCIETY MEETINGS.

- Oct. 6 "NITRATE AND SAFETY FILM-BASE CHARACTERISTICS," by G. J. CRAIG, O.B.E., M.B.K.S.
 Nov. 3 "LENS MANUFACTURE AND RECENT OPTICAL DEVELOPMENTS," by A. HOWARD ANSTIS, A.Inst.P., M.B.K.S., A.R.P.S.
 Dec. 1 "PRESIDENTIAL ADDRESS," by W. M. HARCOURT, F.B.K.S., F.R.P.S., F.R.S.A.

THEATRE DIVISION MEETINGS.

- Sept. 19 "Coloured and Directional Lighting as applied to the Stage," by L. G. APPLEBEE, F.I.E.S., preceded by a film "Fighting Film Fires," by courtesy of the Admiralty.
 Nov. 21 "Modern Kinema Equipment: I—G.K.21 Projector," preceded by a film "Let Us See," by courtesy of the Illuminating Engineering Society.

SUB-STANDARD FILM DIVISION MEETINGS.

- Oct. 13 "The Laboratory and 16mm. Colour," by J. H. COOTE, M.B.K.S., and PHILIP JENKINS, M.B.K.S.
 Nov. 10 "Industrial Newsreels," by Dr. N. BEESE and S. BOYLE, F.R.P.S.
 Dec. 8 "Making Educational Films—A Discussion on the Particular Requirements," by FRANK WELLS.

FILM PRODUCTION DIVISION MEETINGS.

- Oct. 27 "Studio and Outside Broadcasting Television Practice," by T. H. BRIDGE-WATER, A.M.I.E.E. *Joint meeting with Television Society*.
 Dec. 22 "Make-up in Relation to the Photographic Emulsion," by ERNEST TAYLOR.

JOINT MEETINGS WITH A.C.T.

- Sept. 22 "Production Methods Compared," by ALFRED HITCHCOCK.
 Nov. 24 "Filming the XIVth Olympiad—Production Problems and Technical Aspects," by L. CASTLETON KNIGHT.

MANCHESTER SECTION MEETINGS.

Meetings to be held at the Lecture Theatre of the Manchester Geographical Society, 14 St. Mary's Gate, Parsonage, Manchester, commencing at 10.30 a.m.

- Oct. 5 "Some Aspects of Sound Recording," by KENNETH ROSS, A.M.I.R.E.
 Nov. 2 "Technical Visit to Salford Electric Instrument Co., Ltd."
 Dec. 7 "Screen Illumination with respect to the Carbon Arc," by H. DUERDOTH, B.Sc., M.B.K.S., A.R.C.S.

NEWCASTLE-ON-TYNE SECTION MEETINGS.

Meetings to be held at the Lecture Theatre, Newe House, Pilgrim Street, Newcastle-on-Tyne, 1, commencing at 10.30 a.m.

- Sept. 7 "Carbon Brushes for Electrical Machinery," by W. D. HARRISON.
 Oct. 5 "Light Production from the Carbon Arc," by H. P. WOODS, B.Sc., A.Inst.P., M.B.K.S. (to be read by A. B. STUART, M.B.K.S.).
 Nov. 2 "Meters and their Readings," by D. H. THOMAS, M.Sc., A.M.I.E.E.
 Dec. 7 "Coloured and Directional Lighting as applied to the Stage," by P. CORRY.

LEEDS SECTION MEETINGS.

Meetings to be held at the Y.W.C.A., Cookridge Street, Leeds, 1, commencing at 10.30 a.m.

- Oct. 2 "Unit Specialisation in Kinema Equipment," by S. B. SWINGLER, M.B.K.S.
 Nov. 6 "Auditorium Requirements in Sound-Film Presentation: Part I—Picture Projection," by R. PULMAN, F.B.K.S.
 Dec. 4 "Auditorium Requirements in Sound-Film Presentation: Part II—Acoustics," by LESLIE KNOPP, Ph.D., M.I.E.E., F.B.K.S.

THE ORIGIN AND DEVELOPMENT OF THE MATTE SHOT PROCESS

W. Percy Day, O.B.E., M.B.K.S.*

Summary of paper read to a joint meeting of the Royal Photographic Society and the British Kinematograph Society, on January 14th, 1948. The paper will be more fully reported in the September-October issue of the Photographic Journal (Section B).

MR. DAY opened his talk by describing how, in course of his early career as a photographer and portrait painter, he was brought in touch with the Hall process. This system consisted in hanging a painting in position in front of a camera, thus completing a set. The disadvantage of the method (virtually the glass-shot process of today) was that it took too long to marry the painting with the set, which had to be done on the floor of the studio.

Nevertheless, the speaker had used this process for a number of years, notably in pictures produced by the Ideal Film Co. of Elstree. The necessity for a different process arose when it was evidently out of the question to hang an 11 ft. wide painting in a Paris boulevard. Mr. Day recalled a process which he had formerly used in still photography, and the application of it to kinematography was such an obvious improvement that he had not since reverted to the original system.

The first essential was, he continued, a perfectly reliable and steady camera; any displacement of the image due to camera shake would make the shot unusable. "Jiggle," as he termed it, could also be caused through bad perforation or film shrinkage.

Having decided upon the set-up, the part of the scene not required was masked off by placing in front of the lens black cardboard, taking care that the actors were fully covered by the set, otherwise they would disappear in the finished result.

A test of 100 ft. or 200 ft. length was exposed; this test footage was used when joining the painting with the set. The scenes were shot, and the exposed film put in storage, with the exception of five feet of test film, which was developed; an enlargement was made from an image of the test, and the art director made final sketches.

The negative was then projected on to the glass on which the painting was to be made. The projected image had to be carefully drawn in, as the finished painting had to conform to the set on the floor. As the painting proceeded, tests were taken to ensure perfect line-up with the part existing on the exposed section of the film.

When the painting was finished, the unexposed part of the film was exposed to receive the painting. Voltage control was employed to ensure that the light sources for the painting did not vary during exposure. The actual time spent on the floor was negligible, compared with the hanging miniature process. One was able to get a better marrying of the two part-images.

As a modification of the process, it might be necessary to introduce movement in the paintings to give a more realistic effect. A section of a film, "Panique," was projected, showing how a perspective model of a fair was used. In "Anna Karenina" the shot comprised a painting and a model train.

Mr. Day then turned to the adaptation of the process to Technicolor, paying credit to the assistance given by Technicolor in the development of the process.

* British Lion Studio Co., Ltd.

One of the chief complications was "build-up" of the photographic latent image, resulting in a difference between the magenta, green and blue images after the first exposure, when the film was held before development. When shooting the painting a different exposure was required for each strip in order to obtain the same results as in the part already exposed. As an example, in a scene in "Colonel Blimp" a painting required to reproduce grey had to be made vivid green.

The process had been developed in a number of films: "The Thief of Baghdad," "The Four Feathers," "Sixty Glorious Years," and others. Later, however, a different approach was adopted, first used in "Black Narcissus"; the new method eliminated the tedious business of shooting tests before the shooting of actual scenes, and enabled the film to be developed and printed immediately.

When the required takes had been selected, a decision was made where the matte should be placed, always with the consideration that it must not encroach on any part of the image where there was action, and also whether there was any addition in the way of movement, such as clouds, which played an important part in outdoor scenes. The matte line should follow dark shapes, such as shadows.



From "Anna Karenina," by courtesy of London Film Productions, Ltd.

Left—A Studio Set of a Railway Station. Right—Addition of a Roof and Background by means of the Matte Process. The Combined Film was then used as a Background Plate behind a Model Engine.

These points being decided, the image was painted on to glass to match the image of the film projected upon it, following the line where the two had to be photographed to complete the whole. As the film had been developed a dupe was necessary; these, made by Technicolor, had attained such perfection that it was difficult to distinguish the dupe from the original.

One inherent difficulty in shooting the matte was to obtain a density that did not permit any of the latent image being registered when the second half was photographed. When the painting was completed and the dupe ready, tests were shot using a black-and-white camera, which was a saving in view of the limited number of Technicolor cameras available; three films were made with the requisite additive filters, red, blue and yellow.

These black-and-white films were then put in three projectors, and corresponding additive filters were used. It was then only a matter of finding the correct exposures, by changing any one of the images in the projectors, to determine the exposure for the complete shot.

The value of the method, concluded the speaker, had already been proved by the time saved in shooting on the floor or on location. By using a black-and-white camera in processing the shot and by duping the take chosen by the director, a copy could be given to the editor to include in the film until the final result reached him.

VISIT TO M.G.M. STUDIOS, ELSTREE

BY courtesy of Metro-Goldwyn-Mayer British Productions, Ltd., a party of over 200 Fellows, Members, Associates, and Students of the Society visited the company's studios at Elstree on Saturday, May 8th, 1948. Arrangements had been made by Mr. A. W. Watkins, A.M.I.E.E., F.B.K.S., chairman of the Film Production Division, and Recording Director of the studios, together with members of the Division.

Assembling in the restaurant, parties were conducted to Stage D, which was still in the condition in which it was left after the war-time requisitioning of the studios. By contrast, Stage A had been reinstated, and had in fact been recently used on a production. A notable feature was the overhead suspension and feeding of lamps, eliminating cables from the studio floor.

In the preview theatre, Mr. T. W. Howard had arranged a display demonstrating the use of the matte shot process. Three large paintings on glass had clear spaces, through which action was to be photographed. Here were projected sequences from "Idol of Paris" showing the perfection attained by the process.

Messrs. A. H. Wheeler and John Clennell acted as guides in the camera and sound departments. In the former, the variety of cameras, lenses, runtrucks, and other accessories necessary in a modern studio proved a surprise to many.

In the sound department, under the guidance of Mr. L. J. Wheeler, the Western Electric photo-electric densitometer was the centre of interest. Twin light valves, as used for recording the 200-mil push-pull track, were examined with interest.

In the power house, Mr. T. Waterworth demonstrated his equipment, comprising six white-painted motor-generators, taking power from the grid and supplying the studios at 115 v. D.C. A peak load of 50,000 ampères could, he said, be handled.

Mr. Colin Garde was the guide in the excellently equipped make-up department. Of particular interest was the process adopted for producing plastic sections for remoulding features; a metal cast was made of the face of the artist, and a metal mould made from another cast with the desired modification; when the cast and the mould were put together, the space left between was filled with plastic.

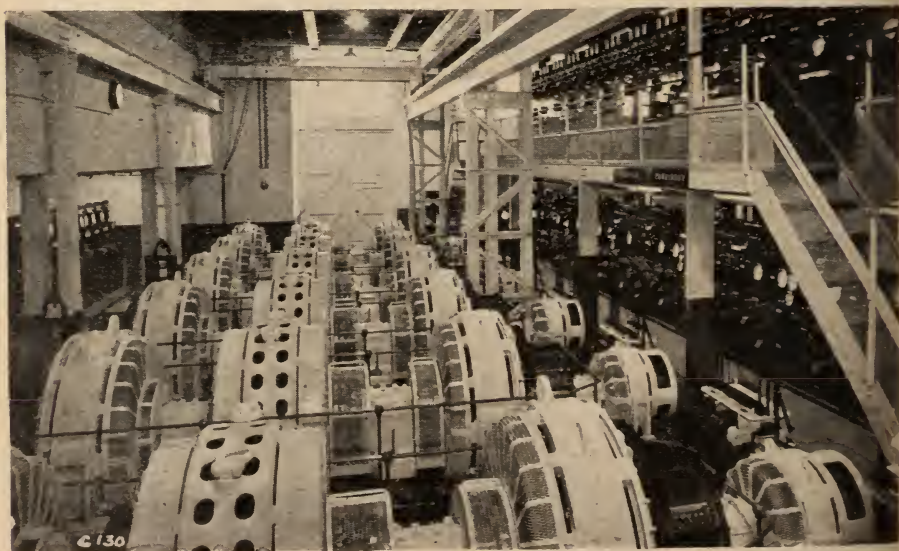


Fig. 1. The Power House.



Fig. 2. Set of Waterloo Station from "The Guinea Pig." The Background is a Photographic Backing.

In the stills department, Mr. David Boulton demonstrated his little studio, and the apparatus for producing large quantities of contact prints and enlargements.

Set Construction

The plasterers' shop is always a centre of interest in a studio. Examples of work in hand included statuary (cast in a gelatine mould), numerous lengths of mouldings, brickwork, and large numbers of ancient weapons.

Numerous portions of sets were under construction in the well equipped carpenters' shop. In the engineers' shop, Mr. H. V. Williams demonstrated components for an optical printer which was under construction, patterns for which had been made in the adjacent pattern shop.

Mr. F. Walter acted as guide on B stage on which were several sets erected for "The Guinea Pig," including a handsome set of the school hall, and an amazingly accurate and detailed reproduction of Waterloo Station. Here again the absence of cables from the studio floor was a marked convenience.

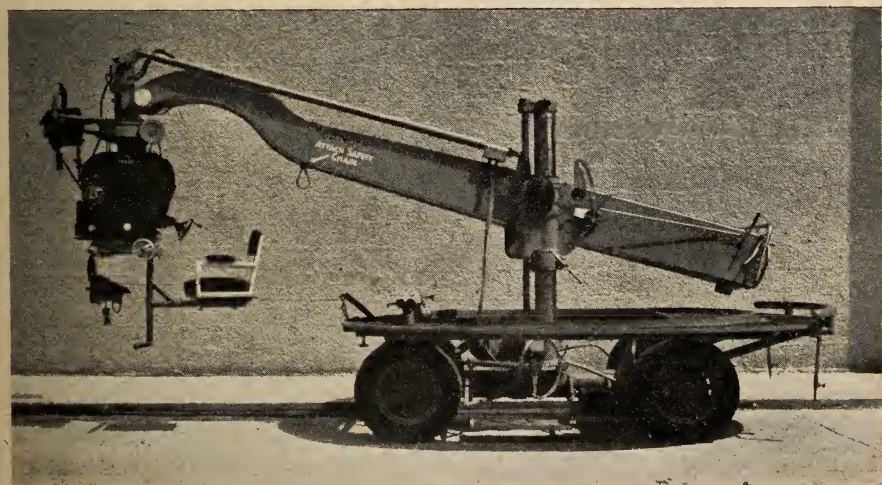


Fig. 3. Camera Crane.



Fig. 4. Another set from "The Guinea Pig."

Wind Machines and B.P. Equipment

After luncheon in the studio restaurant, the whole party assembled on Stage C, where a number of demonstrations were arranged. First, a variety of wind machines were switched on, including that shown in Fig. 5, which emitted a powerful current of air in almost complete silence.

Under the supervision of Mr. Howard, a demonstration of back-projection was given. The Mitchell projector, fitted with a Mole-Richardson 250-amp. lamp, projected a background film upon the 15ft. translucent screen with a very even intensity of illumination and absence of "hot-spot."

The final demonstration was of a newly completed camera crane, with which, thanks to a finely adjustable counterweight, Mr. H. V. Williams was able to swing a Technicolor camera and operator by a touch of a finger. The trucking of the crane was controlled by a mechanic inside the chassis, while the camera operator was able to swing and tilt his camera and himself. Provision was also made for spotlights to move with the camera.

The proceedings terminated with a vote of thanks to Messrs. Metro-Goldwyn-Mayer, to Mr. Watkins and the organising committee and to all those who had assisted in the efficient organisation of the visit.



Fig. 5. Noiseless Wind Machine.

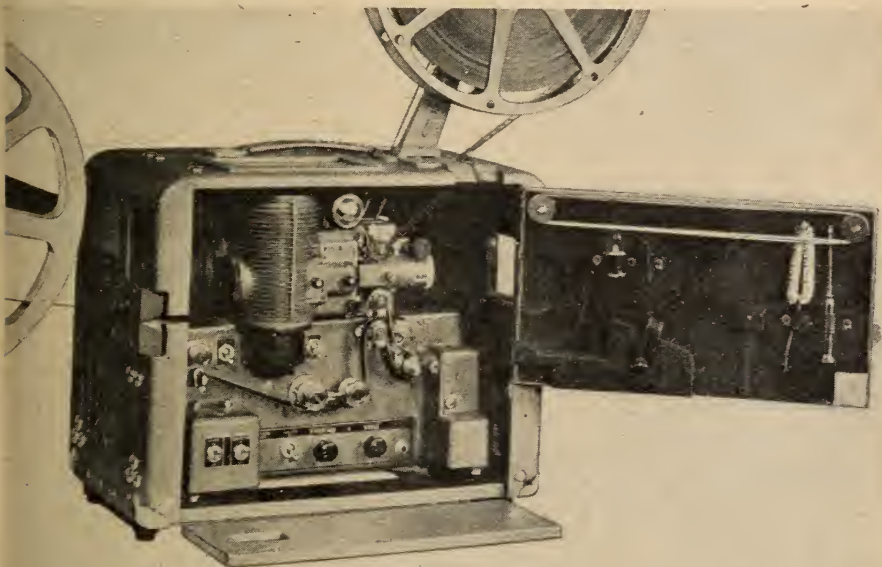
DEMONSTRATIONS OF SUB-STANDARD EQUIPMENT

At the joint meeting of the B.K.S. Sub-standard Film Division with the Kinematograph Section of the Royal Photographic Society, held on April 7th, 1948, new equipment was demonstrated by various manufacturers, and was described by Messrs. Denis Cantlay, M.B.K.S., and Stanley Bowler, F.R.P.S.

BELL & HOWELL-GAUMONT MODEL 601 PROJECTOR*

THE whole of the projector is contained in two cases, one containing the projector and amplifier, together with tools for maintenance, and the other the speaker and leads, and spare film spool. While the projector is supplied with 1,600 ft. spools, the arms will accommodate a 2,000 ft. reel.

The projector is normally supplied also with a 750-watt lamp, but will accommodate a 1,000-watt lamp, in either case with pre-focus cap. The



Magnilite condenser matches the optical system for lenses of short foci. An improved cooling system protects the film against heat damage.

Threading is simplified by the "Safe-lock" sprocket guides, which ensure that the film is either correctly engaged with the sprocket teeth, or is held clear of them. A pilot lamp is fitted.

Sound and silent speeds are available, and a still-picture device, also automatic rewinding, are incorporated. Operating switches are conveniently arranged in order of operation. The self-adjusting take-up device ensures perfect rewinding.

Sound scanning takes place upon a drum carrying a heavy flywheel. Colour or black and white films can be shown, also duplicates where emulsion is on the non-standard side without any adjustment of the optical unit. A wide range of tone control is provided; the amplifier incorporates a negative feed-back circuit, and inputs are provided for microphone and pick-up.

* G.B. Equipments, Ltd.

Simplicity of maintenance is assured by the fact that all optical components can be instantly removed, the gate aperture is easily accessible, while the amplifier can be withdrawn for servicing. Over-oiling is guarded against by the provision of wick lubrication.

BELLMONT SCREEN*

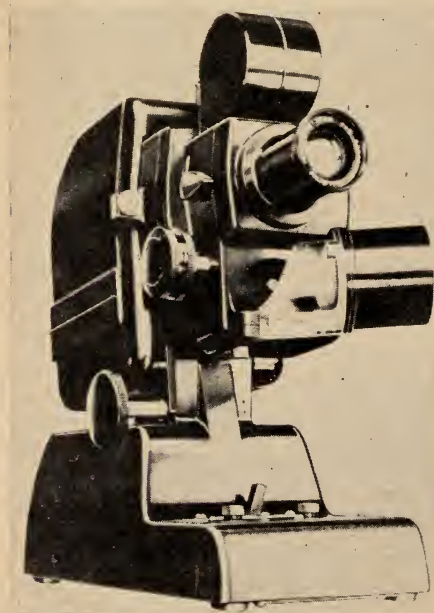
THE "Bellmont" screen has been designed for portability and ease of erection. The screen itself is double-sided, being matt one side and beaded the other; it is obtainable in widths of 50 ins., 60 ins., and 70 ins.

The screen with its tripod stand is carried inside the metal case. The member carrying the screen clips in any position on the stand, and the effective shape of the screen can be either square (for lantern slides) or rectangular.

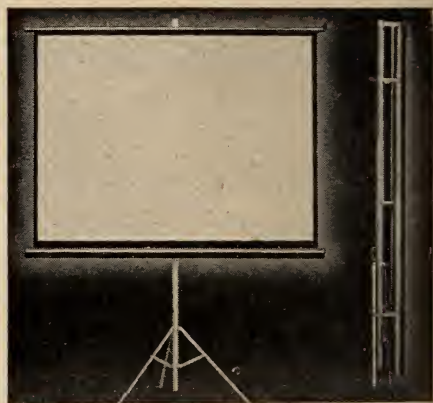
G.B. FILM STRIP PROJECTOR*

THE G.B. Model 38 film strip projector is adapted to show either 18 mm. \times 24 mm. or 24 mm. \times 36 mm. frames, on standard 35 mm. film, or 2 in. slides. It is built of plastic and aluminium. It employs a 12 v. 100-watt lamp, fed either through a built-in transformer or directly from a 12 v. supply. A 3 in. $f/3.5$ objective lens is normally supplied.

The sprocket drive is combined with accurate optical framing. During the movement of the film through the gate pressure is released, eliminating all possibility of scratching. The interchangeable film transport mechanism permits rapid change of film strips. A quick-action tilt is provided.



WESTONE PORTABLE SCREEN†



THE Westone portable screen rolls into a tube to which is attached a tripod. The base of the screen is thus variable between 1 ft. and 4 ft. from the floor. Erection is a matter of seconds.

The screen surface may be either beaded or matt, as required, in all cases seamless, up to a size of 7 ft. 6 ins. \times 5 ft. 6 ins.

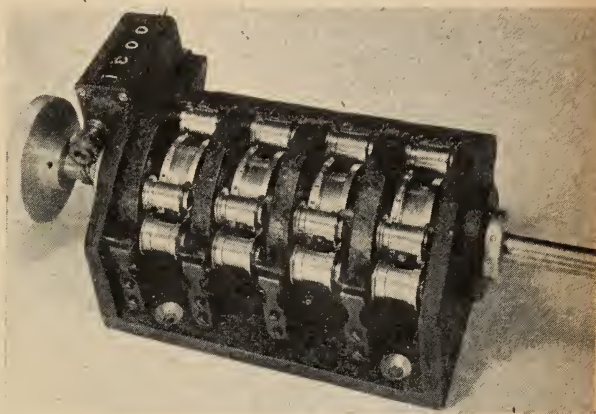
* G.B. Equipments, Ltd.

† Andrew Smith Harkness, Ltd..

16 mm. SYNCHRONISER*

THIS synchroniser, made in two, three or four ways, is of solid construction and weighs approximately 12 lbs. Four-figure Veeder counter is fitted.

The synchroniser is sufficiently massive to stand on a bench without fixing, or it can be mounted on the cutting table; the spindle is sufficiently long to carry a chain drive.



DENSITOMETER†

THIS compact and efficient densitometer enables transmitted densities from 0-2.5 to be read direct from a scale.

It is marketed in a polished mahogany case, with lock and key, and for operation either by a No. 800 dry cell battery or by a built-in transformer.

Illumination is from two 2.5 volt 0.3 amp bulbs, one located below the negative under test, and the other below an annular wedge. One half of the split field, as viewed through the magnifying eyepiece, is due to the negative, and the other half is matched against it by rotating a calibrated annular wedge. The bulbs are automatically switched on when the wedge is rotated from the "off" position.

The optical system is carried in an arm mounted above the negative stage. Negatives of various thicknesses may be examined over an area extending to about two inches from the edge, over a field 3 mm. in diameter.

The instrument is attractively finished in grey stoved enamel and chromium plate.

JUNIOR STUDIO LIGHT†

THIS unit is for use with photoflood (Series 1) bulbs and provides an efficient stand-light for both amateur and professional requirements.

The head unit is a spun aluminium reflector of hemispherical shape with an anodised matte reflecting surface, provided with a handle grip and extension by which it is attached to the stand unit. It is fitted with a B.C. lamp-holder and 9 feet of flex, and is finished in cream cellulose and anodised aluminium. Bulbs are available as an extra.

The stand is a two-section telescopic assembly of chromium plated brass tubing, with a clamping screw on the outer section. On the top of the inner section is a universal clamp device, enabling the head unit to be fixed in any

* E. D. Runkel & Son.

† Ilford, Ltd.



S.E.I. Exposure Photometer



Ilford Junior Light

position. Attached to the bottom is a collapsible tripod.

Maximum height of reflector (centre) ...	...	...	...	...	8 feet
Minimum " " " (centre) ...	...	...	...	...	27 inches
Maximum spread of tripod base (diameter) ...	...	...	...	...	32 inches
Overall length of tripod (closed) .	...	...	...	...	38 inches

S.E.I. EXPOSURE PHOTOMETER*

THE S.E.I. Exposure Photometer† is a portable scientific instrument whereby the light values of very small areas of the subject may be measured with a precision and speed not hitherto possible. Light from a standard source is matched against the subject by the interpolation of filters and wedges in the path of light from either the image or source. The instrument embodies a unique calibration device ensuring accuracy at all times.

Exposure times relevant to any speed of material or camera aperture and subject brightnesses can be read directly from the scales. This instrument may be used with equal facility in the determination of exposures in projection printing.

A leather case is available for this photometer, finished in a dark brown colour and felt lined.

* Ilford, Ltd.

† This instrument was the subject of a paper given by its inventor on April 23rd last, to be reported in a subsequent issue of this journal.

POWER SUPPLIES FOR MOTION PICTURE STUDIOS*

F. S. Hawkins, Ph.D., A.R.I.C., M.B.K.S.

Read to the B.K.S. Film Production Division on January 7th, 1948.

MOST of the power used in a motion picture studio is expended on lighting the sets. This illumination is used only when the camera shutter is open and a frame of film is exposed, and the primary requirement is that its distribution and intensity must be the same each time this happens. The illumination is not required when the shutter is closed. It is also not essential that the illumination should remain constant in intensity during the period when the shutter is open, but the photographic effect of the light must be the same for each frame of film. A secondary requirement is that the illuminators must not cause interference with any other device essential to the making of the film; for example, a high degree of silence is necessary when sound is simultaneously recorded.

It can be seen from these requirements that quite wide variations in the conditions of illumination are theoretically possible. The requirements are fulfilled, for example, by a light source which flashes 24 times per second, the flash being in phase with the opening of the camera shutter; such a flash may have its duration altered over fairly wide limits, provided that the intensity is correspondingly changed, and that no secondary effects intervene.¹ Such systems, however, while they are theoretically possible, usually have practical difficulties associated with them and so are used only when some special effect is desired. For all ordinary lighting of a studio set, steady and continuous illumination is by far the simplest and most convenient form to use.

There are three light sources available for film studio use, namely, incandescent tungsten filament lamps, carbon arc lamps, and high pressure mercury vapour lamps. Each of these light sources has one property in common: it gives a light output which varies considerably with the voltage applied to the terminals of the lamp. It is for this reason that kinema studio lamps are normally supplied with a steady voltage, such as is furnished by a well regulated direct current supply.

I. VOLTAGE CHANGES IN THE POWER SUPPLY

Direct current can be obtained in amounts suitable for studio use from two sources: from a direct current generator driven by a prime mover or electric motor, or from a rectifier which draws its power from the 50-cycle alternating current mains. Both these sources of power suffer a change in the voltage at their terminals as the load upon them changes, unless the necessary precautions are taken to prevent it, and they also have in common another feature of importance in studio lighting: they both supply rectified alternating current, for a direct current generator is, in fact, an alternating current generator fitted with a rectifying commutator, and as a result gives a voltage that is not perfectly steady, it has a ripple.

As changes in voltage of both types may adversely affect the performance of the illuminators, and as no source of direct current is inherently free from these changes, it is desirable that the maximum variation that can be tolerated without detracting from the efficiency of the lighting unit should be known. To avoid confusion between the two types of voltage variation, the voltage which is normally registered by a D.C. voltmeter and which changes with change of load will be called the *mean voltage*, whereas the alternating component which remains after rectification will be the *ripple voltage*.

*Communication from the Staff of the Research Laboratories of The General Electric Company, Limited, Wembley, England.

II. VARIATION OF MEAN VOLTAGE

A change in the mean voltage applied to the terminals of the lighting fitting can affect its luminous output in two ways : it can alter the intensity of the light, and it may also change the colour.

Normally the intensity of the light is measured by methods which refer to the average eye as the light detector. Kinematograph film, however, has a spectral response which differs from that of the eye, and so measurements, either visual or photo-electric, by these methods, can be related with accuracy to the exposure of the film only if the spectral distribution of the light being measured remains unaltered. The three principal types of light sources each have different spectral distributions.

Change of Colour of the Light

A measure of the colour of the light, as seen by the eye, can be obtained by measuring the chromaticity co-ordinates. This has been done for the three light sources under discussion when varying line voltages have been applied to their terminals. The complete fitting, with refractor, was used in these experiments, so that the light whose colour was measured was identical with that which illuminates the studio set. The results, which were obtained with a Donaldson colorimeter, are tabulated below.

TABLE 1.

CHROMATICITY CO-ORDINATES OF LIGHT FROM STUDIO FITTINGS AND ITS VARIATION WITH LINE VOLTS.

Fitting	Line volts	Chromaticity co-ordinates		
		X	Y	Z
150 amp. double negative carbon arc lamp No. 19 carbons.	115	0.326	0.331	0.343
	110	.330	.335	.335
	105	.325	.335	.340
	100	.321	.329	.350
150 amp. double negative carbon arc lamp No. 124 carbons.	115	0.325	0.341	0.334
	110	.328	.342	.340
	105	.327	.342	.331
	100	.330	.329	.341
2½ K.W. compact mercury arc floodlight.	115	0.227	0.334	0.439
	110	.227	.331	.442
	105	.228	.329	.443
	100	.234	.343	.424
2 K.W. tungsten filament spot-light.	115	0.460	0.388	0.152
	110	.467	.385	.148
	105	.481	.377	.142
	100	.489	.373	.138

The data in this table show that there is a negligible variation of colour in light from a carbon arc with line voltage, a fact first reported by Neale² for the single negative arc. The disturbance in colour immediately after a change in current reported by him was found to occur with the carbon arc, and to a limited extent with the mercury arc. In every case sufficient time was allowed for this effect to disappear before readings were taken, the test for

its disappearance being the reproducibility of the results. Readings were taken over a period of one hour for each type of arc to establish the normally occurring variation in the results.

The data also show that the same holds good for the $2\frac{1}{2}$ K.W. compact mercury floodlight; the colour of the light in this fitting is, to the eye, different from that of the carbon arc, but it does not change appreciably as the line volts are altered.

In the case of the 2 K.W. tungsten filament spotlamp there is a steady change in colour; the light becomes redder and less blue as the voltage is decreased.

The figures in Table I give a measure of the colour of the light as seen by the eye. The response of a photographic emulsion will not be the same as the eye, and it is, therefore, possible for two illuminants which differ in colour when observed visually to give the same colour rendering when used for a colour film process. The converse, however, is less probable, particularly when only one illuminant is concerned, and there is no change in the physics of the light emission process. Therefore, as there is no visual change of colour when the line voltage applied to either type of arc is varied, it is probable that there is also no change in the response of the photographic emulsions which are normally exposed to these illuminants.

Change of Intensity of Illumination

The effect of change of line voltage on the intensity of the light is generally much greater, for these fittings, than its effect on the colour. The polar curves given in Figs. 1, 2, and 3 show the extent to which the light is diminished. In the case of the carbon arc the peak candles fall from 1.14×10^6 to 0.88×10^6 candles when the line volts are reduced from 115 to 105, and there is a comparatively large fall to 0.63×10^6 candles when the volts are further reduced to 100. There is a similar fall, though not quite so great in the case of the mercury arc floodlight, the figures being 18×10^3 candles at 115 volts and 12.6×10^3 at 100 volts. The fall obtained for the 2 K.W. spot is intermediate between these two; the tungsten lamp fitting gives 180×10^3 candles at 115 volts and 115×10^3 candles at 100 volts.

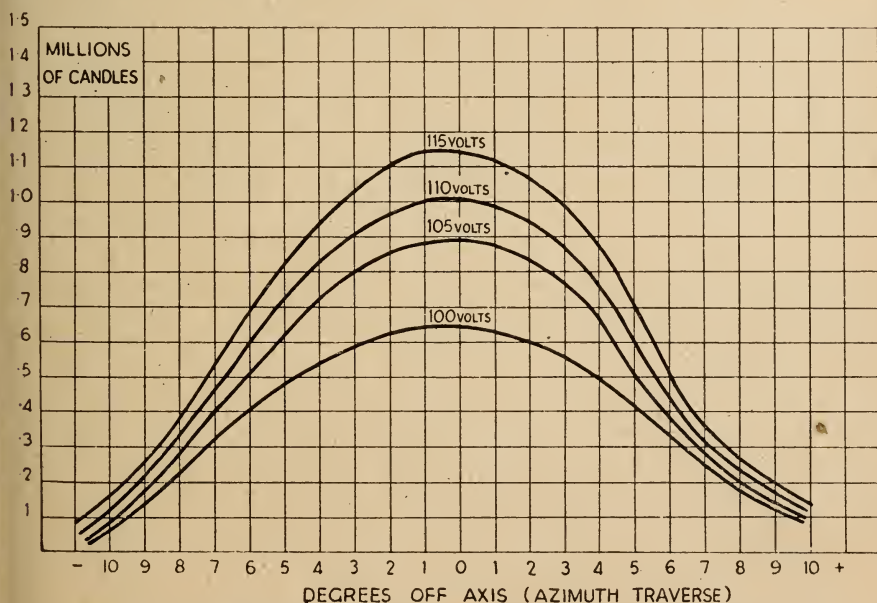


Fig. 1. Polar curves given by double negative arc lamp with change in line volts.

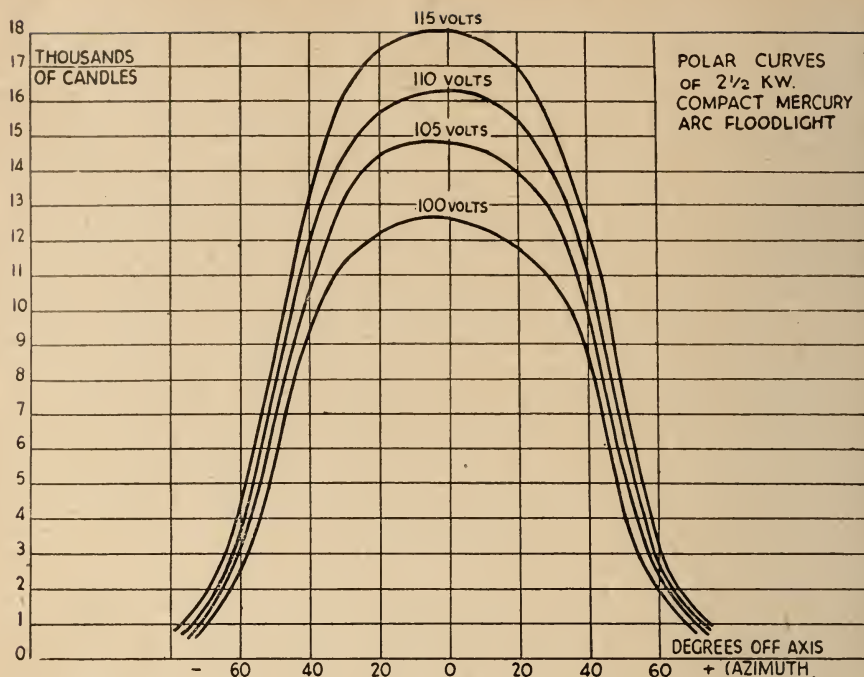


Fig. 2. Polar curves given by $2\frac{1}{2}$ KW. compact mercury arc floodlight with change in line voltage.

Shortly after the measurements described in the previous paragraph were made, similar results were published in the U.S.A. in a report of the Studio Committee of the Society of Motion Picture Engineers.³ Owing to differences in presentation a full comparison of the two sets of results is not possible, but the comparison, so far as it can be made, suggests that the agreement between them is quite close.

Additional Lamps to Compensate for Drop in Line Voltage

The suggestion has been made that a fall in the voltage at the terminals of the lamp is of secondary importance because it causes no change in colour, when colour film is being exposed, and if the light intensity falls then a few more lamps can be switched on to make up for this loss. The following table shows approximately how many more lamps will be required.

TABLE 2.

EFFECT OF LINE VOLTAGE ON LIGHT INTENSITY.

Approximate number of lamps required to maintain a given amount of luminous flux on a set.

Line Voltage	Number of Lamps		
Measured at lamp terminals	H.I. carbon arc	$2\frac{1}{2}$ K.W. compact mercury floodlight	2 K.W. Tungsten lamp spotlight
115	10	10	10
110	11	11	12
105	13	12	13
100	18	14	16

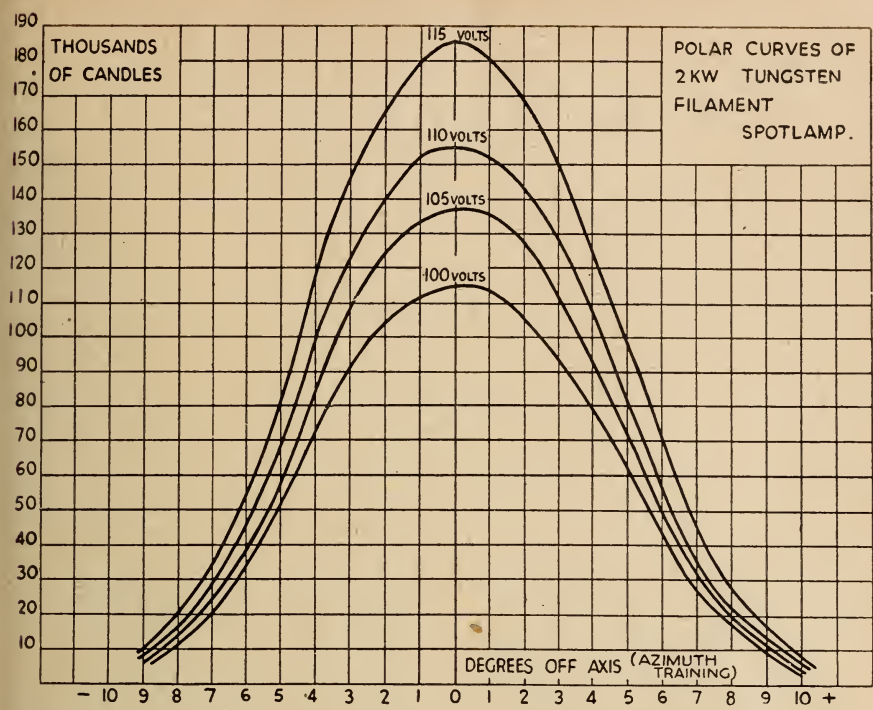


Fig. 3. Polar curves given by 2 KW. tungsten filament spotlight with change in line voltage.

It can be seen from these figures that a drop of five volts below the rated figure requires at least a 10% increase in the number of lamps that are required. Further reduction in the line voltage requires a relatively much greater increase in the number of lamps; if the voltage drops as low as 100 volts then the number of lamps required goes up by 40-80%.

Additional Power required to Compensate for Drop in Line Voltage

If the drop in line voltage is due to losses in the busbars and cables between the generator terminals and the terminals of the lighting fitting, then the increase in the number of lamps required to maintain the luminous intensity, tabulated above, will increase the load on the generating plant. The decrease in the luminous efficiency of the fittings will add still more to the power needed from the generator. The kilowatts required from the generator to light the number of lamps given in Table 2 are listed in Table 3.

TABLE 3.
ADDITIONAL POWER SUPPLIED BY GENERATOR.

Line voltage	Kilowatts supplied by generator					
	Double negative H.I. carbon arc		2½ K.W. Compact mercury floodlight		2 K.W. Tungsten lamp spotlight	
	Lamps	Power	Lamps	Power	Lamps	Power
115	10	86K.W.	10	35K.W.	10	20K.W.
110	11	91	11	37	12	23
105	12	94	12	40	13	25
100	18	125	14	45	16	29

These figures show that if a certain level of illumination is maintained, the load on the power station goes up as soon as the voltage at the lamp terminals falls below its rated value, and the increase rapidly becomes appreciable. Thus, to maintain a given luminous intensity after the voltage at the lamp terminals has fallen from 115 to 105 volts will require an increase in power output of about 9% when double negative H.I. arcs are used, 13% with the compact mercury floodlight and 25% when using 2 K.W. tungsten filament spotlights.

Some improvement on the figures quoted above can be obtained when arcs with ballast resistances are used, by changing the tap on the resistance to correspond with the reduction in voltage. It becomes impractical, however, to keep changing the taps to accommodate comparatively rapid changes in voltage, such as may occur with changes of load, but they can be used to ensure that the average voltage applied to the terminals of the fitting is correct. In the case of tungsten filament lamps, no ballast resistances are used, there are no taps to change, and so the necessity for maintenance of the correct line voltage is correspondingly greater.

The results given in the previous paragraphs show clearly the need for maintaining the rated voltage of 115 volts at the terminals of the lighting fitting, even if this requires a higher voltage of possibly 118 or even 120 volts at the power-house busbar. The polar curves are those of individual fittings and should not be taken as an average representation of these types of fitting.

III. RIPPLE VOLTAGE

There remains for consideration the second type of variation in voltage, the ripple which is found when a rectifier without a smoothing filter is used or when no particular precautions are taken to reduce the slot ripple occurring in D.C. generators. This ripple has not yet been found to be of sufficient amplitude and of appropriate frequency to have any appreciable effect upon the exposed film by causing heterodyne beats between the variation in light output and the intermittent exposure of the film; instead it exerts a deleterious effect upon the recording of sound. It causes periodic electrical forces to be exerted upon conductors which are carrying the current, and as a result they will vibrate and emit an audible note. It is usually the carbon arc that is heard behaving this way and acting as a loud speaker, but other fittings are not always free from blame; any conductor that is free to vibrate will do so.

Effect of Voltage Ripple on a high-intensity Carbon Arc

The effect of applying a voltage ripple to an arc supplied from a steady D.C. source can best be seen by projecting an image of the arc with the addition of a stroboscopic disc to interrupt the light beam emanating from the projector. The changes in the arc are quite complex; some of the changes can be attributed to the change in current through the arc consequent upon the change in voltage, but the causes of other changes are not immediately apparent; possibly the changing magnetic field around the arc plays a part.

The effects which can be attributed to current variations are very similar to the transitory arc changes which occur immediately after the current through the arc is raised or lowered. As the current is lowered, there is a decrease in the volume of the flame between the two electrodes, and a change in its colour from white to blue, followed as the current rises by an increase in the total volume, a reverse change in colour, and an increase in size of the highly luminous tongue of white flame which emanates from the positive crater.

The change in volume does not seem to apply to the outer tail flame, instead it vibrates in a manner analogous to the string of a musical instrument. At

low frequencies it behaves as if its fundamental mode was excited with a node at each end of the flame, but at higher frequencies harmonics appear and the fundamental is of low amplitude. Under these circumstances three or four nodes, and corresponding antinodes, can be seen in this portion of the flame.

Clear reproduction of these effects by black-and-white photography has proved difficult, as many of the effects are rendered visible mainly by the colour contrast they produce. Some of the effects can be seen in Figs. 4 and 5 which are photographs of a 55 ampère arc subjected to about 4 volts ripple at 50 cycles. Fig. 4 was taken at the instant when the current was at a minimum, Fig. 5 at maximum current. The difference in volume of the flame can be seen particularly in the difference in the size of the bulge at the bottom of the arc flame, a difference in colour can be inferred from the clarity with which the inner positive tongue can be seen at minimum current (Fig. 4) as compared to maximum current (Fig. 5). The curvature of the tail flame in Fig. 5 suggests the vibration to which it is subject; any still photograph, however, can give little idea of this effect, which is best seen with a stroboscope or by the projection of a film taken with a high speed camera at about 2,000 frames/second. It can be shown quite clearly with the aid of this camera, particularly if colour film is used.



Fig. 4. An arc burning with a ripple voltage impressed upon the direct current supply. Photographed at the instant of minimum current flow.



Fig. 5. An arc burning with a ripple voltage impressed upon the direct current supply. Photographed at the instant of maximum current flow.

The arc seems to be the most sensitive of the various fittings in a studio to ripple, and so if the supply has its ripple reduced so that the arcs are quiet, then there seems to be no danger that other fittings will vibrate, or that the sound recording equipment will pick up the same note electrically.

Determination of Minimum Audible Ripple Voltage

To measure the least audible ripple voltage it was first necessary to secure an arc burning without ripple noise, and then superimpose upon its supply a ripple whose voltage was measured. The circuit used is shown in Fig. 6, in which the arc is supplied from a generator having a low ripple voltage, with, in addition, a choke to remove the last traces of an audible note. The ripple to be applied to the arc, and to be measured, was generated by a beat frequency oscillator and introduced into the arc circuit via a matching transformer and blocking condenser.

The method used for its measurement was to amplify the ripple by an amplifier whose response was substantially flat between 20 and 7,000 cycles per second, and reproduce the amplified trace upon a cathode ray tube.

Calibration of the apparatus was achieved by substituting for the unknown voltage a known alternating voltage of sine wave form, measured by means of the calibrated voltmeter V.

The known alternating voltage was also generated by the beat frequency oscillator at the same frequency as the applied ripple, and fed into the input of the amplifier after undergoing a definite amount of attenuation.

The arc was burnt in a quiet room (noise level approximately 12 phons), and the ripple was heard by two or sometimes three observers, who were located close to the lamp, not more than 2 ft. 6 ins. from the arc. The voltage of the ripple was reduced until it was inaudible, and then increased until it was just heard. It was found that at all except the lowest frequencies, less than 75 cycles per second, the agreement between the observers and between the minimum audible and maximum inaudible voltages, determined by listening according to the above method, was very close.

When the above circuit was set up, it was found that any transient disturbance in the arc caused a change in the arc voltage and so caused a deflection of the oscillograph trace. These transients are very small in

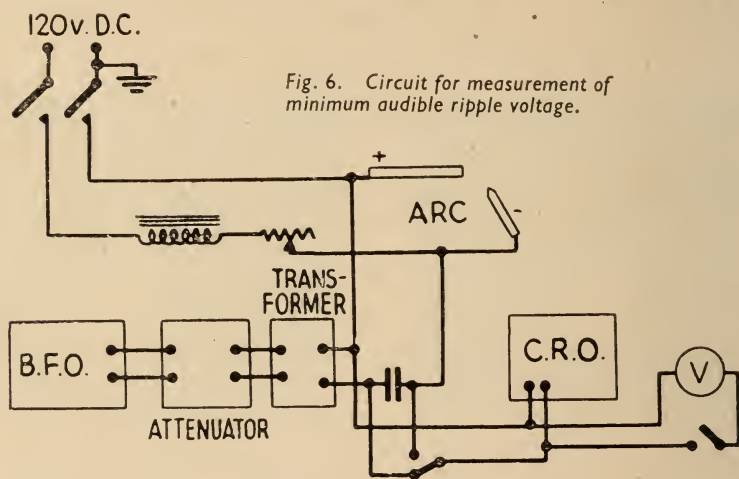


Fig. 6. Circuit for measurement of minimum audible ripple voltage.

magnitude compared with the disturbances caused by a hissing or humming arc, but the minimum audible ripple voltage is also quite small, and as it became smaller in magnitude than the irregular transient voltage it became increasingly difficult to measure its amplitude on the oscillograph screen. The smallest voltages that we were called upon to estimate, 10 millivolts or less, could for this reason be determined only approximately.

Minimum Audible Ripple

The results obtained from tests such as these made upon a 150 ampère studio arc lamp are shown in Fig. 7 which shows that the minimum audible ripple voltage is very dependent upon frequency. It is high near the lower limit of audibility; at 50 cycles its value is 500 millivolts, and it falls rapidly with increase of frequency to 10 millivolts at about 600 cycles/sec. It stays low with further increase of frequency, falling to a very flat minimum of approximately 5 millivolts at round about 6,000–7,000 cycles, and then begins to rise again as the upper limit of audibility is approached and reaches 10–15 millivolts at 10,000 cycles. A comparison of this curve with that of the sensitivity of the ear at the threshold of audibility shows a general similarity of shape.

It is the lower band of frequencies, from 300 to about 3,000 cycles/sec., which are of particular interest to the studio engineer, for the ripple voltages produced by generating equipment—and these are the ones of practical importance—are to be found within this band. An examination of Fig. 7 shows that these voltages are of the order of a few millivolts (22 millivolts at 300 cycles, and 6 millivolts at 3,000 cycles). This leads to the conclusion that the ripple voltage of the supply must not exceed these quite small values if adequate silence is to be maintained by the arcs, and, as these values are smaller than the voltages normally produced by most generating machinery or rectifying equipment, it is usually but not always necessary to insert some form of filter in the circuit which will have the required high impedance to the ripple and low resistance to the flow of direct current. The methods of obtaining this result are briefly reviewed in a later section.

Measurement of Ripple

The points which are given in Fig. 7 were obtained by means of a laboratory

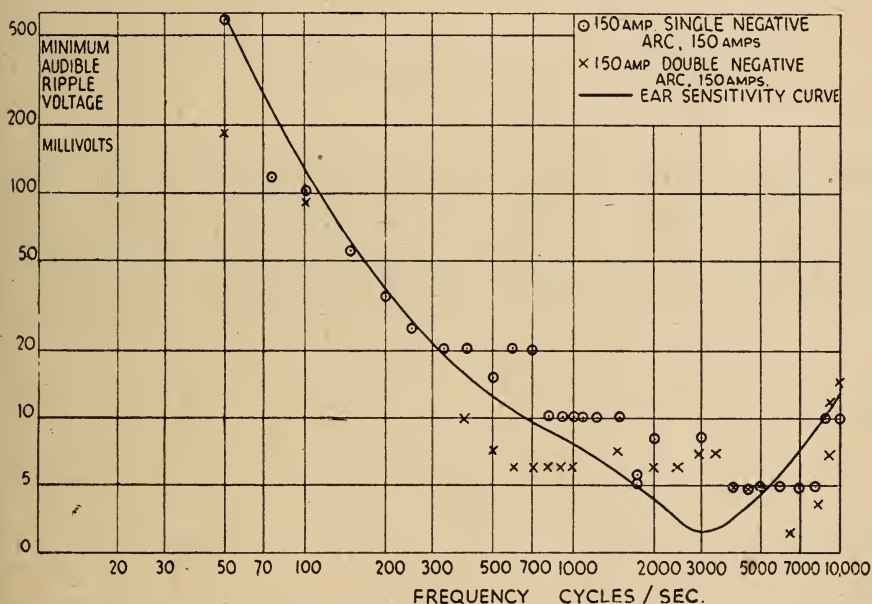


Fig. 7. Effect of frequency of ripple upon minimum audible ripple voltage.

experiment—listening to an arc in a suitable silent room—and it was, therefore, thought desirable to obtain some confirmation of the results they portray. An independent method of checking these results was to measure the ripple voltage actually found in studio power supplies, and then see whether these values, which had been found satisfactory, agreed with those on the curves in Fig. 7.

The problem of measurement was similar to that posed by the laboratory experiment in that it also required the evaluation of a small A.C. component of a substantially unidirectional voltage, but it differed from it in that in the laboratory, the A.C. component was substantially sinusoidal in waveform and of a single frequency having a negligible harmonic content, whereas in the studio it was a complex waveform of considerable harmonic content, which would require evaluation and analysis before a comparison between the results given by the two methods could be obtained.

Methods of Measurement of Ripple

Two methods were available for determination and analysis of the waveform. One was a variation of the method used in the laboratory for the measurement of minimum audible ripple, and in this method the ripple voltage was amplified and its waveform was photographed on the screen of the cathode ray oscillograph. A calibration voltage similar in frequency and amplitude to the ripple voltage was also impressed upon the screen and photographed, and by a comparison of the two traces, the voltage of the ripple could be obtained. The complex waveform was then subjected to harmonic analysis by one of the standard methods, *e.g.* measuring the instantaneous values of the voltage at 24 equally spaced intervals in one cycle, and making a Fourier analysis of the voltage values so obtained.⁴

It was soon discovered that as many of the D.C. generators are used to supply 3-wire systems, with a static balancer to take care of the out-of-balance load, the ripple voltage consisted of a low frequency ripple of considerable amplitude, *e.g.*, 28.4 c/s 500 millivolts, modulated by a high frequency ripple of smaller amplitude, such as 1,080 c/s 30 millivolts. Such a system when analysed by the method given above gives results of the required accuracy only with difficulty, for only the high frequency ripple is audible, and as it appears in the analysis as a high harmonic, in the above example the 38th, it is not easily obtained with accuracy.



Fig. 8. Ripple produced by an unfiltered generator. Example of simple ripple of low harmonic content. (On right, Calibration.)

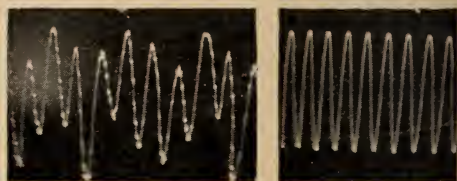


Fig. 9. Ripple produced by an unfiltered generator and static balancer. Complex ripple of appreciable harmonic content.

To eliminate the low frequency components and so improve the accuracy of measurement of those of high frequency, a filter was incorporated whose attenuation increased by 60 db. from 300 to 150 c/s, and this enabled a photograph to be obtained of the waveform given by frequencies greater than this figure separated from the waveform of the lower frequencies. By this means a more reliable analysis was obtained.

The second method used for determining the fundamental and harmonics of the ripple voltage was to use a wave analyser, an electronic instrument in which the ripple voltage is applied to a sharply tuned circuit whose resonant frequency is, in effect, varied, and the voltage of any constituent of the ripple voltage corresponding in frequency to that of the tuned circuit is read, after amplification, by a valve voltmeter. A substantial measure of agreement was found when the results obtained by these two methods were compared.

Results of Measurement of Ripple

Examples of the results obtained by these methods are given in the following figures and tables. Fig. 8 is a straightforward example of the ripple given by a generator before being reduced by a filter or choke to a value low enough to make it suitable for studio use. The calibration trace is a ripple of 1 volt at 1,000 c/s, and a comparison of the two shows that the generator ripple has a frequency of 1,400 c/s and an amplitude of 6 volts r.m.s. at this frequency. It is clear from an examination of the waveform of the ripple that its harmonic

content is unlikely to be high; the use of the wave analyser showed that there was in fact second harmonic present to the extent of 0.32 volts and third harmonic to 0.07 volts.

This example is exceptional in that the ripple voltage is high and of comparatively simple waveform. It is usual to find a much more complicated state of affairs, such as is shown in Fig. 9. In this case comparison with the calibration trace shows that the predominating frequency is one of 85 c/s, although a closer inspection of this and similar oscillograms shows that this frequency is not always constant in amplitude and that in fact it repeats itself in groups of three cycles. The fundamental frequency is, therefore, 28.4 c/s.

A still closer inspection of the waveform, however, shows that there is a component of much higher frequency present, as can be more clearly seen in an enlarged view of the trace (Fig. 10), and, furthermore, the amplitude of this high frequency component is not constant. By using the high-pass filter with a cut-off at 300 c/s it is possible to remove from the trace the 28.4 and 85 c/s components, with the results shown in Fig. 11. Here the high frequency component alone remains and its variation in amplitude is clearly visible. It is principally made up of two components, frequency 995 and 1,080 c/s the 35th and 38th harmonics of the fundamental of 28.4 c/s. They beat together and so cause the variation in amplitude. A fuller analysis of



Fig. 10. Complex ripple of Fig. 9 reproduced with a wider time scale.

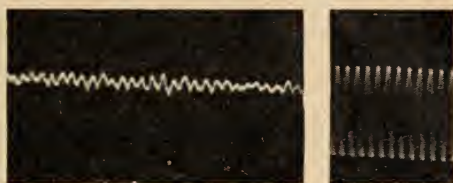


Fig. 11. Ripple shown in Fig. 10 with low frequency components removed by filter.

the low frequency traces by the methods previously indicated was made, and in addition the wave analyser was used and its readings were found to confirm the results obtained. The complete analysis is given in Table 4.

TABLE 4
ANALYSIS OF RIPPLE.

Frequency Cycles/second	Amplitude Millivolts (r.m.s.)
28.4	480
56.8	90
85	770
114	90
142	20
170	30
199	100
227	10
284	30
995	40
1080	30

The components in bold type are of sufficient magnitude to be audible when an arc is supplied by this generator, and so a filter would be required to make this equipment satisfactory for use in a studio power station.

By means of the methods outlined in the above paragraphs the ripple which reached the arcs was measured in a number of studios. The results are given in Fig. 12, which contains the data given in Fig. 7 and, in addition, the ripple voltages measured in the various studios; the latter are represented by the prominent black dots with a circle around them.

Twenty-nine measurements are plotted in this figure, and twenty-five of these are at or below the minimum audible ripple voltage measured in

the laboratory, while the remaining four are not largely in excess of the expected values. It was, therefore, concluded that the laboratory measurements were confirmed by the subsequent studio results shown in this figure.

IV. EQUIPMENT

The data given in the previous sections of this paper show that it is essential that the voltage at the terminals of the illuminator should remain constant. There is no technical difficulty in the design and manufacture of either generating plant or rectifiers which with the aid, if need be, of a filter for ripple suppression will deliver the necessary power.

Generators and Rectifiers

If there is A.C. power available from the grid or other public supply authority there is the choice of installing either a pumpless steel tank rectifier or a motor-generator set. The necessary voltage control in the case of the

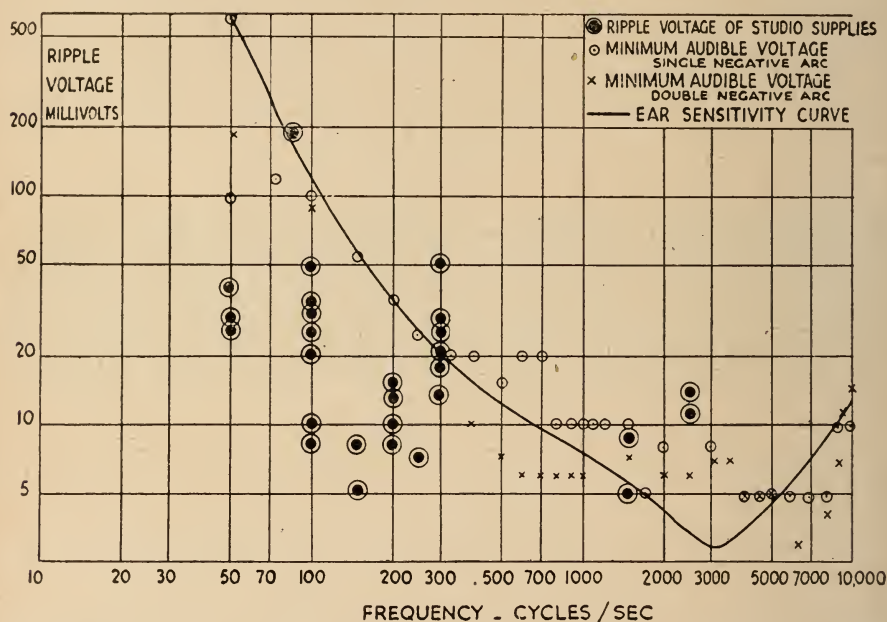


Fig. 12. Ripple voltages measured in the studios, together with minimum audible ripple voltages.

rectifier can be obtained by an induction regulator, or by the action of control grids on the ignition of the rectifier arcs; the removal of the ripple is effected by means of a suitable filter. Such control will correct a voltage fluctuation whether it arises from change of load in the studio or change of mains voltage on the A.C. input. In the case of a motor generator set, the disturbing influence of voltage changes in the A.C. supply can be eliminated by using synchronous motors to drive the generators, for, in normal circumstances, when the frequency of the supply is kept constant, the generators will be driven at constant speed, and even at the present time the variations are comparatively small. Voltage changes arising from change in load can be sufficiently reduced either by the use of level compounded generators, or automatic voltage regulators with shunt wound or suitably compounded generators. Ripple from a generator can be considerably decreased by suitable design; a small filter can also be used if necessary. Similar generators are used when the power is obtained from prime movers, usually diesel engines.

As each of these sources of direct current can be made equally satisfactory from a technical point of view, the choice of the type of equipment for the power station is largely determined by economic considerations.

Chokes and Filters

The ripple present in a D.C. supply can be reduced by connecting in series with the D.C. load an inductance or choke coil which has a high impedance to the ripple, but a low D.C. resistance, together with a capacity in parallel with the D.C. load. The latter has a low impedance to the ripple and a very high D.C. resistance, and so offers the ripple an alternative path.

It has been the practice in the past, particularly when only a few arcs required silencing, to use a choke in series with each arc lamp without a parallel condenser. Such an arrangement is simple and effective, but suffers from the disadvantage that if the choke is portable, its D.C. resistance is appreciable and the voltage at the lamp terminals is decreased by the voltage drop in the choke. Thus a choke suitable for use with a 150 ampère arc lamp would have characteristics similar to those shown in Table 5.

TABLE 5.
PROPERTIES OF ARC LAMP CHOKE.

Inductance with 150 ampères D.C. flowing	6 milli-henries
D.C. resistance	0.09 ohms
Weight	220 lbs.
D.C. volt drop at 150 ampères	13.5 volts
D.C. watts dissipated at 150 ampères	2,030 watts
Impedance at 300 cycles/sec. with 150 amps D.C.	11.3 ohms

These figures show that such a choke is quite heavy ; even so it dissipates just over two kilowatts and, therefore, runs quite hot.

The inclusion of a large enough capacity in the circuit in parallel with the D.C. load enables the inductance of the choke to be decreased to about 20 micro-henries, *i.e.*, by about 300/1, without increasing the ripple voltage at the terminals of the illuminator. Consequently it is possible to make a choke that will carry much heavier currents without an excessive D.C. volt drop, and it becomes practical to smooth the whole output of a generator by means of one filter, instead of connecting individual chokes to each lamp. When capacities are used in this way the filter takes on the conventional form of a low-pass filter, and its parameters can be calculated by the usual methods. Typical values for the chokes and condensers are of the order of 20 micro-henries for the inductance of the choke and 20,000 microfarads for the capacity of the condensers.⁵

Power Distribution

While there are no technical or economic difficulties in maintaining a constant voltage at any one point in the supply, *i.e.*, at the power station busbars, distribution systems of the conventional type make it difficult to maintain a corresponding constancy at the terminals of all the illuminators. In the usual arrangement there is a central power house, and heavy copper or aluminium feeders running from the power house to the studios, frequently with the formation of a ring main. These carry the direct current, which may amount to 10,000 amps. or more, even when a three-wire system is used,

and if the volt drop is to be kept to a low figure, then feeders having a large cross-sectional area are required. These become an expensive item when either their length is great or cross-sectional area is very large. In addition, there is the voltage drop in the flexible cable between the contactor panel on the grid and the lighting fitting, which in the case of the cable normally used for the 150 ampère arc is about 1 volt per 50 feet of single-core.

The voltage drop in the busbars will depend upon the load they are carrying, that in the head leads and extensions will depend upon their length, and it is easily possible for the total voltage drop between the power station busbars and the terminals of a lighting fitting to be as much as 5 volts. About half of this drop will be in the head leads and extensions, the remainder will be in the feeders. The elimination of this loss of voltage is desirable, as it causes a disproportionate decrease in the efficiency of the lighting fittings, but it is difficult to achieve without a radical change in the method of distribution.

Acknowledgments

The measurement of the ripple of the power supplies in the various studios could not have been made without the assistance of the studio engineers concerned, and particular acknowledgment is made of the help they have given. The J. Arthur Rank Organisation, the British Lion Film Corporation, the Associated British Picture Corporation, and the Alliance Film Studios are also thanked for permission to make these measurements in their studios.

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2. D. M. Neale. *J. Brit. Kine. Soc.*, 1946, 9, 140.
3. Report of the Studio Lighting Committee. *J. Soc. Mot. Pic. Eng.*, 1947, 49, 279.
4. See also "Waveform Analysis," by R. G. Manley.
5. B. F. Miller. *J. Soc. Mot. Pic. Eng.*, 1943, 41, 367.

DISCUSSION

Mr. C. HILLYER: Has Dr. Hawkins any information on the rectifiers used in studios and on the smoothing?

THE AUTHOR: In one rectifier in use, the ripple is 11 volts 300 c/s before smoothing. There is a conventional filter which reduces the ripple to quite a safe figure.

Mr. A. W. WATKINS: We in this country are ahead of the United States in rectification, and it seems a shame not to take advantage of that.

Mr. F. G. GUNN: In cases where you have two similar generators driven by one motor, is it possible that the ripple frequencies could be in opposite phase, and therefore self-neutralising?

THE AUTHOR: Yes, but it would mean a very rigid coupling, as the ripple from a generator is nearly always slot ripple.

Mr. S. A. STEVENS: The displaced phase coupling together of generators is the very thing you can do more simply with rectifiers. By doubling the phases, the ripple percentage would be reduced to a quarter. But there is a snag if you try to carry this phase multiplication too far—that the three phase voltages are not quite equal, with the result that you get from your multi-phase rectifier a certain amount of ripple at lower frequencies, such as 50 and 100 c/s.

Mr. F. BUSH: There is liable to be a distinct difference between the voltage at the generator and where it is actually used on the floor. I should have thought it would be useful to have voltmeters on the floor.

THE AUTHOR: That is a good practical point;

it would be preferable to have the voltmeter somewhere near the lamp.

Mr. R. H. CRICKS: A number of years ago I designed a studio arc lamp with a voltmeter. It was objected that it was impossible to keep a voltmeter in good condition on the studio floor.

Mr. S. A. STEVENS: Is there not a suggestion that instead of using one group of generators or rectifiers, you should take the power via a high-tension cable as a ring main, and rectify it as close as possible to the studio floor?

THE AUTHOR: There is much to be said for a distribution at 2,000 or 3,000 volts, and mobile transformer and rectifier stations which you could move around. But it would be a radical departure from accepted practice.

Mr. T. WATERWORTH: The particular problem of studio power supply is that usually you want practically the whole of the output of your station on a given stage. If you have a number of stages, you have a large amount of equipment to move about, and rectifiers need an enormous weight of smoothing equipment.

Mr. C. G. HEYS HALLETT: Is it not a fact that bus-bars in studios have been cut too much? It might be better to have more copper than to have 50 tons of ironmongery on wheels.

Mr. B. HONRI: At Ealing Studios we have installed the additional power required for Technicolor on a mobile truck, which is available for use elsewhere when we are shooting black-and-white.

Mr. F. G. GUNN: In your opening remarks you

said it is only necessary to have the light on when the shutter is open.

Mr. W. S. BLAND : It has been tried in the States with discharge lamps. But one of the troubles is that the discharge is so rapid that they get a sharply defined image, which gives a very bad flicker. That scheme would be very useful if it could be carried out with a portable vibrator and a low-voltage accumulator, for news-reel work.

THE AUTHOR : There are other disadvantages. One is that the sound engineers would not like it :

most things when they give a flash also give a click.

Mr. W. BLAND : Such equipment is usually required by silent cameramen.

Mr. H. WAXMAN : There are serious drawbacks, physical and psychological. It is impossible for the cameraman to see the set as with an integrated light. Secondly, there is the effect on the nerves : can one imagine what it would be like to work in a studio where all the lights were flashing ?

Mr. W. BLAND : Another thing is that tubes have so far a life of only 10,000 exposures.

TECHNICAL ABSTRACTS

Most of the periodicals here abstracted may be seen in the Society's Library

BRIGHTNESS AND HUE OF DYES IN RELATION TO COLOUR PHOTOGRAPHY.

M. E. Clarkson and T. Vickerstaff, *Phot. J.* (B), March, April, 1948, p. 26.

The authors investigate theoretically the domain of colours which may be met with either hypothetical dyes or with the best existing dyes, and show that there is still considerable room for improvement. They then analyse the possibilities of colour reproduction with various primaries and various reproducing dyes. They conclude that the most serious error is unwanted absorption by a reproducing dye in a region in which it should transmit. Finally, they analyse the reproduction to be expected with Kodachrome and Technicolor, which was substantiated experimentally.

M. V. H.

TOXICITY OF CARBON ARC GASES.

Leroy W. Latowsky, *International Projectionist*, Feb., 1948, p. 10.

Experiments with inhalation of original carbon arc fumes by test animals and comparison with inhalation of pure nitric oxide and nitrogen dioxide show that the real toxic danger lies in the inhalation of the nitrogen-oxygen compounds, created by the action of the arc, especially high intensity arcs. Adequate ventilation removes this danger effectively. The recommendations of the Projection Practice Committee of the S.M.P.E. for proper ventilation are given.

H. K.

T. A. Filipi, *International Projectionist*, March, 1948, p. 14.

The author reports former experiments in this field and appreciates the findings of Latowsky. He points out, that also apart from the projectionist's profession, carbon arc fumes have given rise to the danger of toxicity, and stresses that, considering the widespread use of carbon arcs in industrial and medical practices, this chapter should be made a subject of Public Health.

H. K.

A MODERN SOUND-REINFORCEMENT SYSTEM FOR THEATRES.

C. E. Talley and R. W. Kautzky, *J. Soc. Mot. Pic. Eng.*, Feb., 1948, p. 149.

The paper describes a newly installed system at the Roxy Theatre, New York, designed for aiding the presentation of elaborate stage shows. It also permits the output from sound film projectors and the now enclosed kinema organ to be relayed over the speakers. Thirty-two stage microphone pick-up points and four organ microphones are catered for in the installation, and methods of controlling the unusually large number of channels are described.

N. L.

THEATRE TELEVISION—A GENERAL ANALYSIS.

Alfred N. Goldsmith, *J. Soc. Mot. Pic. Eng.*, Feb., 1948, p. 93.

The paper is a review of the requirements, present position and future trends of theatre television. Half the paper is concerned with a review of the technical requirements, such as picture size, viewing conditions, brightness and resolution ; the other half deals with cost factors, programme problems, methods of syndication and interconnection between theatres or cities.

The final section is the proposed procedure for exhibitors who wish to enter this field in a successful manner. While the final design of a commercial television equipment is not yet available, nor have the requirements of the programmes been studied in detail, the author suggests that now is the time for all the problems, in particular those associated with programme presentation by television, to be gone into along the lines which he indicates.

T. M. C. L.

POLYTECHNIC CLASSES

AS in past years, three series of evening classes will be held at the Regent Street Polytechnic during the coming scholastic year. The lecturer is Mr. Malcolm Hoare, B.Sc., M.B.K.S.

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Meeting of August 11th, 1948

Present : Messrs. W. M. Harcourt (*President*), A. W. Watkins (*Vice-President*), E. Oram (*Hon. Secretary*), R. H. Cricks (*Secretary*), W. L. Bevir (*Acting Secretary*), and Miss S. M. Barlow (*Assistant Secretary*).

Secretaryship.—It was agreed that Mr. W. L. Bevir should be appointed Secretary of the Society.

Honorary Members.—It was agreed to offer Honorary Membership, while they are studying in this country, to the holders of seven fellowships offered by the B.F.P.A. awarded through the United Nations Educational, Scientific and Cultural Organisation.

Library Committee.—A letter from Mr. Rex B. Hartley withdrawing his resignation from the Chairmanship of the Library Committee was received with much satisfaction.

Education.—The Education Committee's proposals of July 26th were considered and it was agreed to refer these to the Council.

Lecture Programme.—Final arrangements for the lecture programme for the 1948 Autumn session were reported.

Elections.—The following were elected :—

JAMES BLAKE DALRYMPLE, M.C., A.R.P.S. (Member) (Photographer-Director).

REGINALD CHARLES NEILL (Student), Regent Street Polytechnic.

RONALD COPPLEMAN (Student), Regent Street Polytechnic.

GEORGE EDWARD MOUSELL (Associate), W. Vinten, Ltd.

Mrs. DOROTHY MAY STIMSON (Member), Film Studios, Manchester.

FREDERICK NEWMAN BENHAM (Member), Gainsborough Pictures, Ltd.

JOHN STURGEON (Member), Cinesales, Ltd.

CHARLES TOMRLEY (Member), Technicolor, Ltd.

HENRY JOHN DENHAM (Associate), British Acoustic Films, Ltd.

PETER RALPH EYRE TANNER (Member), Ealing Studios, Ltd.

Transfer.—From Membership to Associateship :—GEOFFREY BUSBY.

Resignations.—The following resignations were accepted with regret :—

C. F. TRIPPE (Member).

CHARLES FREDERICK SMITH (Member).

ALBERT C. J. BOLTON (Member).

DOUGLAS FAWCETT (Associate).

GEORGE UNDERWOOD (Associate).

ANTHONY SQUIRES (Member).

PERSONAL NEWS of MEMBERS

OSMOND BORRADAILE was the subject of an article in a recent issue of *The Leader*.

C. R. GIBBS, of the British Film Institute, offers a 35 mm. Moy Film Gauge for sale to any member for a nominal sum.

JOHN P. SAYER has been appointed assistant manager of the Tatler Theatre, Boar Lane, Leeds, having left a similar position with the Capitol Cinema, Leeds.

C. J. WHEELER is in charge of the Cine. Department of W. A. Lancaster, in Cairo, and is also supervising the production of films in Dufaycolor at Studio Misr, Cairo.

Members are requested to inform their staffs

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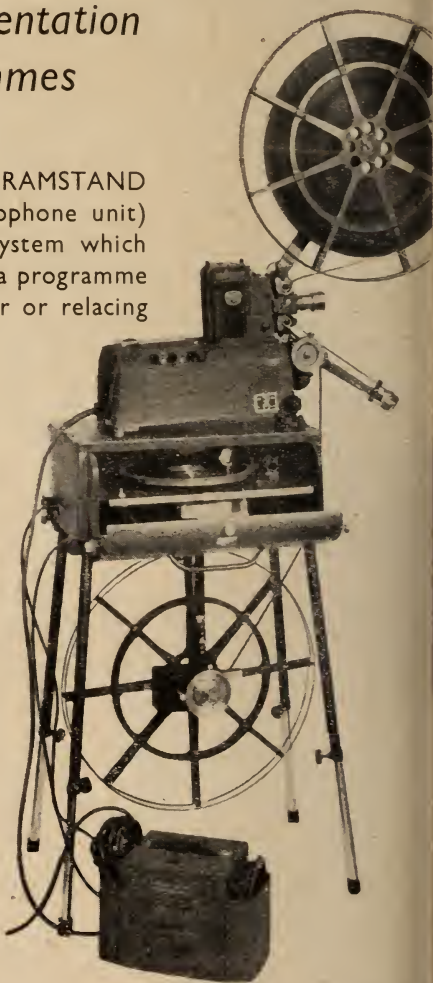
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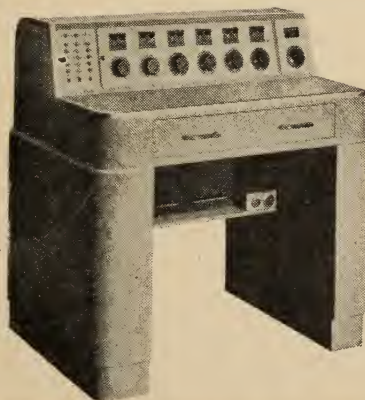
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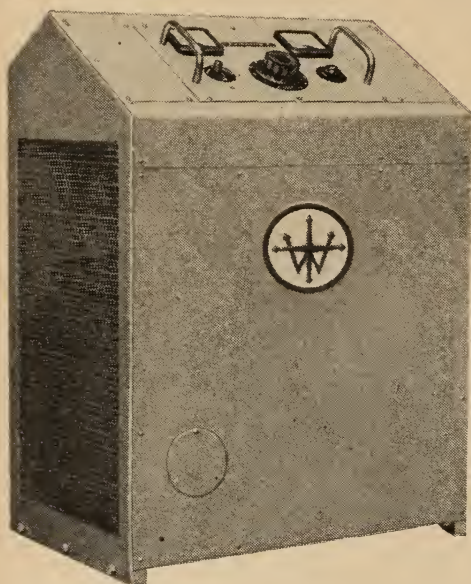
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BRITISH KINEMATOGRAPHY

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THE PROCESSING OF COLOUR FILMS

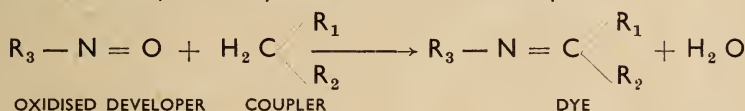
J. Howard Jacobs, M.A., M.B.K.S.*

Read to the B.K.S. Film Production Division on February 25, 1948.

M^{R.} JACOBS first dealt with the various physical and chemical methods of obtaining colour, citing photo-elastic stress analysis¹ as a practical application of a physical effect, and dyeing as an example of a chemical method. Of all the dyes that had been described² only a very small proportion were of use photographically. These had been adequately dealt with by Tull³. Although the mechanism of the appearance of colour in dyes was not fully understood, it was possible to suggest one on the basis of the Quantum Theory⁴, and it was expected that further application of this and wave-mechanical concepts would enable dyestuff research to proceed by less empirical methods in the future.

I. DYESTUFFS

Many dyes could be formed by a coupling process (Feertype⁵, Diazotype⁶), and it was shown how colour development was a special case of this. Although experiments had shown that the actual mechanism was often more complicated⁷, it was sufficient here to regard the reaction as one of oxidation of the colour developer by the silver bromide, followed by condensation with the coupler :



The structures of couplers were then considered and it was shown that the groups R_1 and R_2 activated the CH_2 group so that the hydrogen atoms became labile. Two structures for the dye formed from acetoacetanilide were given, the change from one to the other being accompanied by the absorption of a quantum of light radiation.

The speaker then turned to the practical application of the dyestuffs to the making of colour pictures. A brief account was given of the working methods for stripping film and printing from matrices (Technicolor⁸, Kodachrome⁹), anchored coupler material (Agfacolor¹⁰, Anscoolor, Gevacolor, Ektachrome, etc.), and a procedure based on Feertype. In the last process the film was sensitized with a diazo-sulphonate which would not couple until it was decomposed by ultra-violet light. It had recently been proposed to use this for making colour prints, by printing with three diazo salts in turn on the same film.

Turning once more to the anchored coupler materials Mr. Jacobs continued :

*Denham Laboratories, Ltd.

THE chief interest which these anchored-coupler materials have in the motion-picture industry derives from the fact that they may be processed with little alteration to a film laboratory's machinery. There seems very little chance of Kodak's producing Ektachrome or anything similar in long 35mm. lengths for processing by the film laboratories; and the German Agfacolor plant at Wölfen is of course in Russian hands. But there are one or two firms within our reach who are evolving processes fundamentally of the Agfacolor type. In the hope that this sort of material will be in fair supply shortly, let us examine the processing requirements.

When such a process does arrive, it will be of the negative-positive type, and the ability to make dupes will be of paramount importance for full-scale motion-picture production. Using an integral masking technique, the making of dupes with little loss in colour values is definitely in prospect.

II. PROCESSING METHODS

Various accounts of the Agfacolor negative-positive process have been published¹¹, and no useful purpose would be served by repeating them. It is proposed mainly to deal with the problems which confront a laboratory which is already turning out large quantities of black-and-white film, and which we may suppose now to be considering the possibilities of changing over to colour.

The problem of duping has already been touched upon. Other questions which at once present themselves to a laboratory operator thinking along these lines are:

- (a) What new plant do we need, or what modifications to old plant?
- (b) What new materials will be required?
- (c) How do we set about controlling the whole process from set lighting through negative processing, duping and optical work, to the preparation of the final release prints, complete with sound tracks, and their subsequent projection in a large number of very different kinemas, so that the results are well-balanced, pleasing and reproducible?

These are just a few of the many problems involved. To give the answers, unequivocally and in detail, would require more experience with this type of colour film than most of us in this country have had up to this time. The author will attempt to indicate the nature of these problems, and the lines along which they might be solved in particular circumstances. For it should not be forgotten that film laboratories are not all identical; each one is individual, and details which apply to one do not necessarily suit another.

Diamine Poisoning

The developing agent used with this type of film is diethyl *p*-phenylenediamine. All materials of this kind are liable to cause skin irritations, or "diamine poisoning" as it is called, in those who handle them. There are various non-toxic modifications of this material being worked out; but in the meantime, it should be treated with respect, and all precautions taken against this form of dermatitis. Hands should be rinsed after contact, with 1% hydrochloric or acetic acid, followed by ordinary washing and thorough drying. Application of a good skin cream is also beneficial.

Colour Developer

The developing solution, which is the same for positive as for negative processing, contains a strong alkali which brings the pH value up to about 10.5. This is not only necessary to make the colour developer work with reasonable speed, but it also helps the subsequent coupling action.

The solution may also contain a clearing agent, such as hydroxylamine

hydrochloride, and a small amount of sulphite—too much would compete with the colour couplers for the oxidised developer. Water softeners and wetting agents may be added. The developing agent itself is added in the form of the hydrochloride, the sulphate, or the sulphite.

Negative Processing

The negative film, after six minutes' developing, undergoes five more stages before being dried. These are : spray washing, bleaching, washing, fixing, and a final wash.

The spray washing immediately after development serves to remove all traces of developing agent which would produce colour fog if it were allowed to be oxidised in the emulsion later. The importance of this wash cannot be over-emphasised ; lack of thoroughness here can completely ruin the film. Another effect, due to careless processing, may occur when an acid stop bath is used directly after a developer containing carbonate. Carbon dioxide gas is evolved in the emulsion, causing a blistering effect. If a stop bath is used, it is often advisable to have a short rinse first.

The bleaching bath oxidises the silver image, leaving the dyes untouched. It consists of potassium ferricyanide together with an acid buffer. Good quality stainless steel is essential for equipment with which this bath is used, as otherwise iron going into solution reacts to form prussian blue, which, besides using up chemicals and steelwork, rapidly clogs the bath and gets on the film. There is bound to be some formation of blue in any case, but usually the particles are so fine that they remain in suspension. These may appear on the film, after it has been dried, as a very fine white bloom ; this may be removed by including a bath of very dilute acetic or oxalic acid—about 0.1 to 0.25%—at some stage between the bleach and the final wash. It must be sufficiently dilute not to affect the dye images.

The fixer is neutral hypo with perhaps a little sulphite, and is followed by spray washing where possible. In view of the fact that integral tripack film is particularly prone to reticulation and frilling, a hardening bath may be included, preferably early in the processing chain. White light may be used as soon as the developer has been washed out of the film.

Positive Processing

As the positive film will be carrying a sound track, the processing procedure will vary according to the policy adopted with respect to the track. Dye sound tracks transmit, and therefore cannot modulate, much of the infra-red to which an ordinary photo-cell is sensitive.

There are two possible solutions. One is to use a different photo-cell¹². The antimony-caesium cell, the sensitivity of which shows peaks in the blue, gives very good results ; it will also perform well on silver tracks, so there is a case for re-equipping kinemas with it.

The alternative is rather troublesome : to retain a silver sound track. The bleach is made up with a highly viscous " filler "—an oxy-methyl cellulose has been used—and applied with a special nozzle to the picture area only of the film. When this has done its work, it is wiped off and the film is washed with jets of water. The silver has now been removed from the picture area, but remains in the sound track. This may now be reproduced with a conventional photo-cell.

The film also contains a colloidal silver yellow filter, which has to be removed from *all* parts of the record, including the track. This is dealt with before the viscous bleach by a separate bath—an ordinary bleaching bath diluted 20 : 1. There is also a sulphite clearing bath after the viscous bleach. In all, there may be up to eleven stages before the film is dried,

and a developing machine is required with a corresponding number of separate compartments. Sometimes it is possible to subdivide the compartments in existing machines. In other cases, it may be necessary to build on extra units; or perhaps two machines can be modified and coupled up to form one large one.

However it is decided to arrange this, it is very necessary to provide means, if not already existing, for keeping the temperature of the developing bath as steady as possible, and of the other solutions and washes as close to this as practicable, to assist in the prevention of frilling and reticulation.

Two-colour Work

There will of course have to be variations in the processing to suit the particular film stock that becomes available. To give one example of this, it is considered by many that there is scope for a two-colour process, particularly for newsreels and shorts, pending the full-scale introduction of an integral tripack film. One stock manufacturer has been experimenting with the production of a bipack emulsion with anchored couplers, and a few notes on this may be not out of place.

The negative has a red-sensitive layer containing a magenta coupler, and a green-sensitive layer with a cyan coupler. A yellow filter is used when printing this on to the positive, and viewed through this the negative layers appear red and green respectively. Thus the couplers are not in their normal positions in the layers; ordinarily the cyan coupler would be in the red-sensitive layer, and so on. In this case, it implies that the film has been produced exclusively with a view to a negative-positive process. Any attempt to reverse this film would produce red foliage and green faces.

The positive has the same scheme of sensitisation and couplers, so that it fits in with the negative, and in the development a yellow coupler, say acetoacetanilide, is added to the bath to change the magenta colour to red and the cyan colour to green. This procedure compensates for the use by the manufacturers of couplers applicable to a three-colour process in a film which has only two layers. The processing of the positive is liable to be somewhat delicate on this account. Addition of the yellow coupler causes the slow formation of dye in the solution due to aerial oxidation, with consequent instability in the concentration of the coupler. This would not in itself be serious, were it not for the fact that this coupler is competing for the oxidised developer with the couplers already anchored in the layers. The latter are of fixed concentration, and any variation in the concentration of yellow coupler, up or down relative to the anchored couplers, will have the effect of swinging the colours developed in the two layers between yellow and magenta, and between yellow and cyan, respectively. If a good balance is to be maintained, it is essential to keep a close watch on the concentration of the dissolved coupler.

Another point about this coupler is that the dye it forms appears to be less stable than those formed from the anchored couplers. In particular, the acidity of baths such as short stop, hardener and bleach must not be too high, or they will decompose the yellow dye. Any pH below about 5.5 should be considered dangerous.

III. CONTROL OF BATHS

These remarks bring us to the subject of bath control by chemical analysis. This technique seems to be in increasing popularity as far as black-and-white processing is concerned, and it is worth noting that Agfa preferred it for colour work. Sensitometric control was only used as a secondary check. This underlines the necessity for close temperature control of the developing

bath. If all its constituents are closely controlled, it should be possible to rely on it to produce a definite result.

Although colour sensitometry will be referred to later, the technique may be regarded as of interest principally to the stock manufacturer.

Analysis of Developing Agent

There are several ways of ascertaining the concentration of colour developing agent. One may proceed as for metol, either by the ether extraction method of Atkinson and Shaner¹³, or by an ethyl acetate extraction, followed by a potentiometric titration, as developed by Stott, by Gloyns, and by Levenson¹⁴. The titration is carried out with ceric sulphate, using calomel and platinum electrodes.

Alternatively, the diamine may be estimated colorimetrically. Briefly, the procedure is as follows :

A portion of the developing solution is acidified and boiled to get rid of the sulphite. It is then made alkaline again, and excess of a coupler and an oxidising agent, say ferricyanide, are added. The dye formed by this operation is extracted with a suitable solvent—preferably one of the less volatile ones—and estimated in a colorimeter.

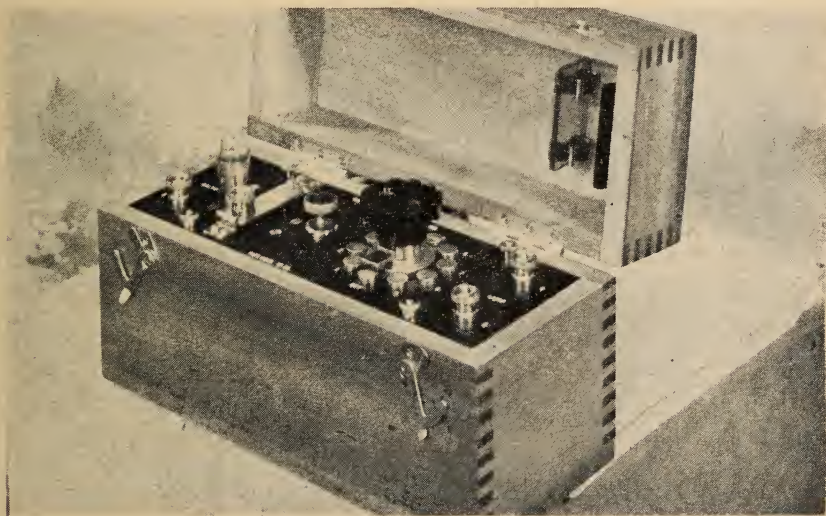


Fig. 1. Gambrell Colorimeter.

While it is possible to do this visually, a photo-electric instrument is to be preferred, as Fig. 1. The sample is put in a cell or a test tube, and light from a lamp is passed through it, and strikes a barrier layer photo-cell at the end of the instrument ; the current from this is indicated by an external galvanometer. The intensity of the lamp may be varied with a resistance, or for fine adjustment by changing its position relative to the rest of the system ; provision is made for a filter which, for maximum sensitivity, should be of a colour complementary to that of the dye being examined.

It is necessary to calibrate the instrument with samples of known diamine content. When there is coupler in the solution, this may be estimated by the same method. In this case, excess developing agent is added, followed by the oxidising agent.

Hydroxylamine, if present, may be determined by a titration after interfering materials have been removed. The developing agent is removed by

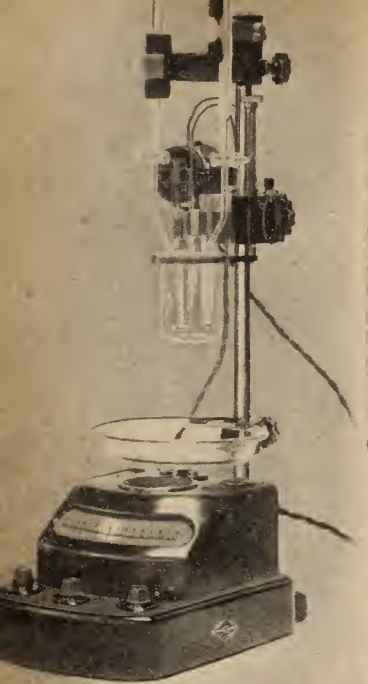


Fig. 2. Cambridge Electrometric Titration Apparatus.

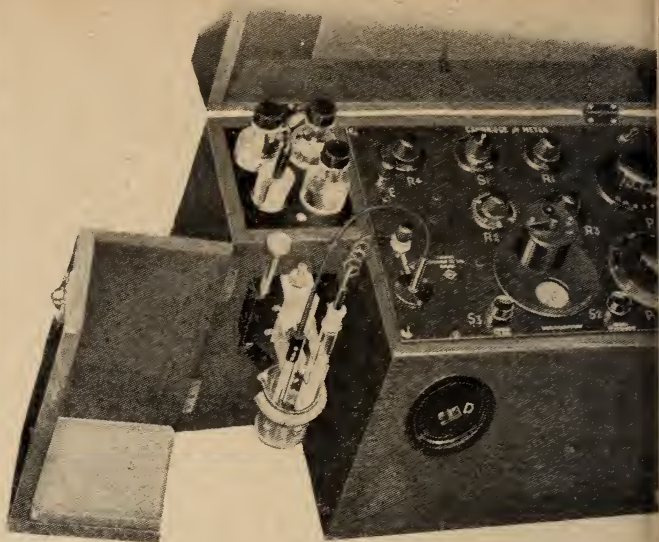


Fig. 3. Cambridge pH Meter.

extraction with ethyl acetate. The solution is then made acid and boiled to remove sulphite. An excess of iodine is added, and the mixture is brought to a pH of 8 with a buffer solution. The excess iodine may then be back-titrated with thiosulphate. This particular procedure avoids aerial oxidation of the hydroxylamine which otherwise occurs very easily.

It is inadvisable to estimate the bromide by a straight titration with silver nitrate using an absorption indicator, if the solution contains chlorides, as it often does. It is preferable to do the titration potentiometrically, when separate end-points may be obtained for bromide and for chloride¹⁵. The electrodes used in this case are mercurous sulphate, and silver with a coating of silver bromide. Fig. 2 illustrates one type of potentiometric titration apparatus, showing the electrodes, stirrer and motor, burettes, galvanometer and controls.

The sulphite content and alkalinity of the developer are determined in the normal way, as is the pH . A pH meter is the first essential for the control of any developer. On the instrument shown in Fig. 3 a pH reading takes only a few minutes. Such a meter is also useful for pH measurements on the stop bath, the bleach and the fixer.

Analysis of Bleach and Fixer

A used bleach bath will contain ferricyanide and ferrocyanide, as well as perhaps bromide or phosphate, depending on the formula used. The ferricyanide is estimated by turning out iodine from excess potassium iodide solution in the presence of zinc sulphate and titrating with thiosulphate. The ferrocyanide may be found by titrating with ceric sulphate or chloramine T. The bleach bath, unless greatly diluted, is highly coloured, so using an internal indicator is not always easy, and end-points are best found potentiometrically.

The analysis of the fixer follows normal practice for thiosulphate and sulphite: the sulphite is rendered inoperative with formaldehyde, and the thiosulphate is then titrated with iodine. The sulphite is obtained by difference from a further iodine titration without formaldehyde.

Silver Recovery

As regards silver recovery, it is understood that the electrolysing of neutral

fixing baths is somewhat unsatisfactory. It is therefore necessary to acidify before electrolysis, either by working a batch recovery method, or by running it off into the main black-and-white fixer circuit. The Germans tried a base-exchange resin for silver recovery, but no information is available about this material. A similar process was tried for stop bath regeneration.

IV. SENSITOMETRY

Black-and-white sensitometry methods may be used to obtain general information about the density and gamma being produced by a colour developing bath. Details about what is happening in the individual layers may be had by fitting a densitometer with three relatively narrow-band filters of red, green and blue to assess the cyan, magenta and yellow layers, respectively. A difficulty which often occurs here is due to the lack of sensitivity of the densitometer set-up when a filter is in position. This was solved in one instance by using an electron multiplier in place of the normal photo-cell¹⁶, this gives a vast amplification with considerable stability, and is a most effective answer to the problem.

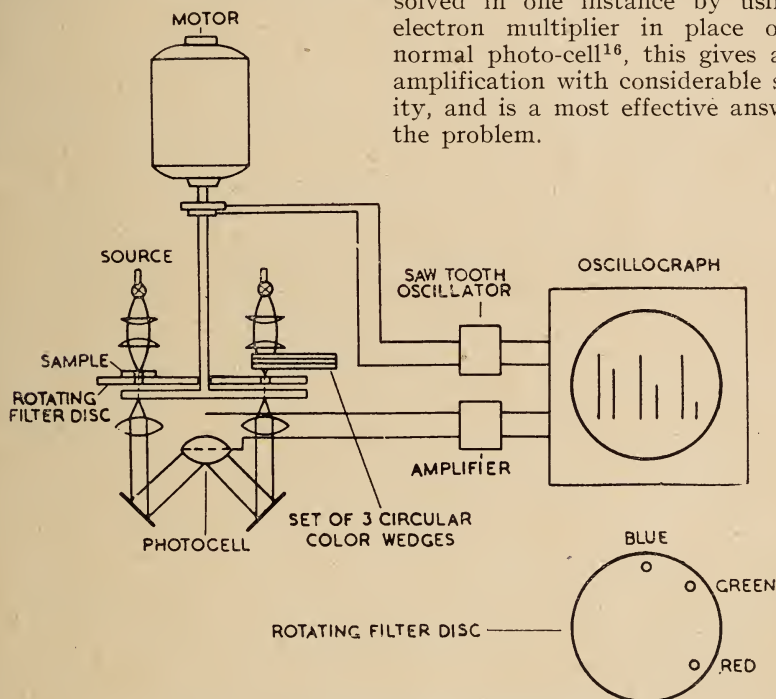


Fig. 4. German Electronic Colour Densitometer.

It is advisable to exercise caution when interpreting the results from such an instrument. The dyes in the film are by no means ideal, and in practice each absorbs colours besides the one intended. For instance, the available cyan dyes, which should absorb only red, also absorb heavily in the green, and to a smaller extent in the blue. Hence the cyan layer will influence the reading obtained with the green filter on the magenta layer, and so on.

If the absolute densities in the layers should be required, there are two ways of ascertaining them. Matrix equations may be used¹⁷ to evaluate these densities from the readings of integral densities obtained in the three regions of the spectrum. These equations are the same as those used in working out masking techniques¹⁸. If the characteristics of the dyes are known, the required results may be calculated. Where a considerable amount of data has to be dealt with, it is advisable to use a machine or sets

of tables. A simplified version of the Malloch electrical machine or some similar electrical analogue computing apparatus is required¹⁹.

The other approach is to use three wedges, made from the actual dyes used in the film, to match the colour and density of the sample. This procedure gives a direct reading of the absolute densities in the layers.

Fig. 4 shows diagrammatically an electronic instrument designed along these lines in Germany²⁰. A similar visual instrument has been described in America²¹. The German version measures six densities automatically and continuously. These are the densities of the sample to blue, green and red light, and similarly those of the comparison wedges. This is accomplished by rotating a disc of filters in the optical paths so that each reading is taken in turn by a single photo-cell. The densities are presented as a series of vertical lines on the screen of a cathode-ray tube, the heights of the lines giving a relative measure of each density. In operation, the wedges are rotated one by one until their densities are equal to the densities in the sample; the equivalence is indicated by equality of the lines on the oscilloscope, taken in pairs.

Colour Sensitisation

In connection with sensitometry, reference should be made to the relation

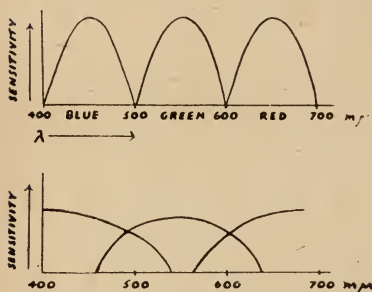


Fig. 5. Ideal Sensitivity Curves.

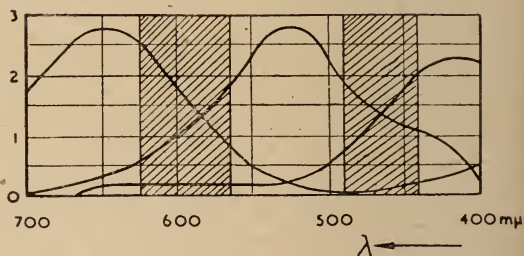


Fig. 6. Positive Sensitisation Diagram with Negative Dye Absorption Curves.

between the negative and the positive in this type of colour film. This will pave the way for the subject of printing.

The negative is colour-sensitised in three bands. While at first sight it would appear that very sharply defined sensitivities, as in the upper curves of Fig. 5, would help in the reproduction of saturated colours, this is not entirely borne out in practice. To take an extreme case, lines of the spectrum which fall in the gaps between the sensitivities would not be reproduced at all. Furthermore, coloured objects which have sharp absorptions at or near these gaps would appear in the print with too much white. The Agfa-color negative is therefore sensitised somewhat along the lines shown in the lower curves.

These limitations do not apply to the positive. Here the requirement is to pass on the information in the negative as accurately as possible. The colour in the negative is, after all, just coded information which has already been suitably distributed into three channels. The overlapping and consequent interference of the three dye absorption curves, in the processed negative, make it essential that the positive shall have sensitisation in narrow bands, in order to pick out the absorption maxima of the dyes in the negative. In Fig. 6, the light areas are regions of sensitivity, and the gaps are shaded. It will be seen that the gaps eliminate much of the overlapping parts of the curves, which are those of the negative dyes.

One result of this type of positive sensitisation, is that it requires a negative which is, from the visual point of view, out of balance. This is because the negative is intended to be "viewed" only by the positive, and the sensitising of the latter bears no relation, as we have seen, to that of the human eye.

Yet another approach to the sensitometry of the negative follows from these considerations. A practical evaluation is to be obtained with an instrument constructed to react to the negative in exactly the same way as the positive would react. This has been done by arranging a spectroscope with a set of masks in the plane of the spectrum. These masks are made of exactly the same shape as the spectral sensitivity curves of the positive. A step wedge on negative film may then be examined by uncovering each mask in turn and allowing the emergent light to be collected by a condenser lens and photo-cell.

V. PRINTING

The positive film is balanced for printing by tungsten light, which must be of constant colour temperature. The temperature itself is less important than the fact that it must be held steady. This requirement at once rules out all printers with resistance light changes. Variable apertures, bands with holes punched in them, or any other mechanical means are permissible; but not resistors, which change the colour-temperature of the light.

Where necessary, correction in the colour balance of the print is made by inserting filters of the primary subtractive colours in the optical path. In order to determine which filters to use, and of what density, a fairly elaborate grading system is called for. This involves printing one frame from each of a number of filter combinations. The filters are numbered from 5 to 100, in twenty steps of 5 each, according to their colour density. This is arranged so that one filter each of cyan, magenta and yellow, all number 100, give a grey density of 1.0 when viewed one behind the other.

Various devices have been used for positioning the right filter in the optical system of the printer at the right moment. Perhaps the most convenient is an adaptation of the DeBrie system of light control, using a band in the printer light path, moved intermittently; gelatine filters may be clipped over the holes in the band.

Colour Grading

In order to produce a test print for grading, a band may be made up containing all combinations of filters, Nos. 30, 60 and 90, as well as several diaphragm steps. One frame is exposed for each combination, and the print is given a standard development. Inspection of the result will immediately reveal which filter combination has given the nearest to a neutral print. A further run may then be made with closer intervals between filter densities near the optimum ones previously found.

This method of working with subtractive filters has the advantage that an off-balance negative or positive stock may be designated by the six figures denoting the filter combination which will correct it to neutral. When both negative and positive are off-balance, it is merely a matter of adding the two sets of figures to find a starting point for grading. There will of course be other factors upsetting the colour balance—in particular, the conditions under which the negative was exposed.

Darkroom Safe-lights

There is one other matter which properly belongs to this section: that of darkroom illumination. The negative film with its overlapping sensitivities

has to be treated as fully panchromatic ; but the positive film has relatively large gaps in its colour sensitivity, and use may be made of one of these gaps if a sufficiently narrow band light is used.

In the case of Agfacolor, yellow sodium light may be used. This is monochromatic when suitably filtered ; the film is safe even when exposed to quite bright illumination of this type, provided exposure is not too prolonged.

Colour Masking

Earlier the problem of making dupes was mentioned. The difficulties of working a colour process for which a good duplicating technique is not available need not be stressed. The early German Agfacolor feature films suffered from this trouble ; to avoid duplicating, and the consequent loss of colour saturation, three perfect takes had to be made for each shot. An approach was made to this problem as follows :

The application of masking film to the duplication of reversal colour processes²² is today well known. For the negative-positive process a method has been suggested whereby a silver mask is produced, not on a separate support, but in the colour film itself. Instead of colour-developing the original negative to a gamma of .5 to .6, it is developed to a gamma of .8 to .9. This increases the saturation of the colours, but produces too high an overall contrast. The latter is cut down by the production of a positive mask of gamma .3. After colour development and bleaching, the film is only partially fixed, exposed to white light, and redeveloped in a black-and-white developer.

To secure a positive image in the negative, it is necessary to use a bleach bath, which produces in the emulsion a silver salt which fixes out faster than the original silver bromide. This salt (*e.g.*, the chloride) is removed by the partial fixation before redevelopment. The duplicates are then made by reversal from this masked negative.

VI. PHOTOGRAPHY AND PROJECTION

The processes taking place in the laboratory have now been described. But the chain of events neither starts nor stops there. Although such matters are strictly outside the scope of this paper, it must be stressed that the best possible processing cannot give good results if either the shooting or exhibiting conditions are at fault.

Exposure is, of course, not as critical as with a reversal colour process ; but care is still necessary about studio lights, which, except for special effects, should be all of the same type. Arc lights give a very constant colour temperature ; but incandescent lighting is apt to vary, not only with the ageing of a particular lamp, but also amongst a batch of new lamps. A careful check has therefore to be made on close-ups to ensure that one side of a player's face is lit by light of the same colour temperature as the other. Arcs are much safer from this point of view.

As regards projection, it is generally accepted that the minimum light requirements are higher than for acceptable black-and-white showing. The human eye does not see colour very well unless the illumination is quite bright ; hence the difficulty of distinguishing colours even in bright moonlight. Other variables to be coped with are the colour of the projection light and the colour of the screen.

The speaker concluded his paper by illustrating the C.I.E. and R.U.C.S. systems of colour measurement²³ by means of some Agfacolor reproduction tests, and also showed a number of transparencies by the Kodachrome, Ektachrome, Agfacolor, British Tricolour and Gevacolor processes.

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DISCUSSION

Mr. EMMY: I seemed to notice that with all the colour films the green was not as good as the yellow, red, or blue. Is this the fact, or is it my imagination?

THE AUTHOR: It is probably due to the fact that the greens are most familiar to us. The very fact that one is used to them makes one more likely to pick holes in them. The primary dyes are selected with reference to a great many factors, and one cannot always choose them so all colours are reproduced well.

Mr. EMMY: Would it be possible in that case to do something with the light sources to make up for the deficiency in green sensitivity?

THE AUTHOR: I have not spoken of deficiencies in green sensitivity; but it might be that they were the *wrong colour*. There might be a general shift rather than a lack of brightness.

THE AUTHOR (in reply to another question): I do not want to go into the whole

question of colour masking. The idea in the case of Agfacolor is that if development be taken to a higher gamma, more brilliant colours are obtained, but the overall contrast is much too high. Therefore the contrast is cut down again by using a black-and-white mask of the reverse sign; if a negative is being developed a positive mask will be used. Something is still gained in saturation; but again, it is a compromise.

Mr. IRWIN: Can any statement be made as to the possibility of using Agfacolor for motion picture film in this country?

THE AUTHOR: Certain manufacturers are experimenting with the production of Agfacolor-type material. I do not know how far they have got.

Mr. F. G. GUNN: One can understand the difficulty of manufacturers in this country in putting down the necessary plant and machinery, but the same conditions do not necessarily apply in America, although in our own Society Mr. Williford has explained

that the biggest problem they have is the lack of manufacturing and coating facilities.*

Mr. L. ISAACS : I should like to ask about exhibiting conditions and how the yellow tungsten light would affect the blues.

THE AUTHOR : I mentioned exhibiting conditions in my paper, but I did not regard it as my sphere to say much on the subject. It is important to have light of the right colour for exhibiting, and also of sufficient brightness.

A MEMBER : It is suggested that less brilliancy is required for colour than for black-and-white.

Mr. F. G. GUNN : The British Standards Institution has investigated this problem and has stated that the minimum illumination requirements are a little lower for colour than for black and white.† But, generally speaking, taking into account all the factors that obtain in practice under operating conditions, they propose a standard which could be achieved at the moment if they make reservations as to its being

an ideal. It is suggested that the standard might be reviewed later when more powerful sources of illumination are available.

A MEMBER : Can Mr. Jacobs tell us anything about additive processes?

ANOTHER MEMBER : Is the bath reasonably stable and can one use circulation and boost?

THE AUTHOR : I have not tried additive processes at all. Yes, one can use circulation and boost provided one does not put a coupler in the bath. If that is done it loses strength very quickly.

Mr. SEGALLER : The diagram which Mr. Jacobs showed of the carbon molecules suggested that all of them were of the benzene type.

THE AUTHOR : All dyestuffs are combinations of coal-tar products fundamentally and if they have not benzene rings they have some other sort of ring structure. As regards the colour of a particular dye, it is a question of calculating the energies of particular states of the molecule.

* See *Brit. Kine.*, Nov. 1947, p. 142. † See B.S.S. 1404 : 1947.

BOOK REVIEWS

THE ARCHITECTS' MANUAL OF ENGINEERED SOUND SYSTEM. Architectural Relations and Sound Equipment Section of Radio Corporation of America. 11 in. × 8½ in. 288 pp. Price, \$5.

It would appear that the American architect takes a greater interest in the work of the acoustic and electrical engineer than his colleague in this country, and although this book is written primarily as a guide for architects, it contains a mass of information and detail which should prove to be of use to all technicians interested in the recording and reproduction of sound.

Much space is devoted to descriptions of microphones, amplifiers and speakers and the plans of cable and equipment layouts. The book adequately deals with the design and installation of sound equipment in studios, control rooms, schools, hospitals, churches, theatres and cinemas. Each section is treated in considerable detail and is illustrated with carefully prepared diagrams. L. KNOPP.

THE BRITISH FILM INDUSTRY YEAR BOOK, edited by John Sullivan. (Film Press, Ltd.)

As the title indicates, this book caters for those engaged in the industry and is an excellent "Who's Who" on technicians and stars. It also provides for the material aspect of the industry, with detailed sources of information for everything required in film making. Ten sections give concise

information and not only stars but technicians have been given short biographies, together with the list of films with which they have been associated. Of special interest is the full text of the agreement between the A.C.T. and the B.F.P.A.

A. W.

INFORMATIONAL FILM YEAR BOOK, 1948. (Albyn Press, Edinburgh. 12s. 6d.)

The 1948 Informational Film Year Book, second of the series, contains a wealth of information for those interested in the 35 mm. and 16 mm. informational film. Seven useful articles by knowledgeable authors appear, together with 22 lists of everything the documentary enthusiast wants to know, from "Who's Who" to cine. stockists, and pre-view theatres to publications.

A. W.

WINCHESTER'S SCREEN ENCYCLOPEDIA. Editor : Maud M. Miller. (Winchester Publications, Ltd. 21s.)

Maud M. Miller has done a magnificent job in assembling information of such magnitude that only the title of encyclopedia can do it justice. It is a film fan's paradise, and the technician's most compact reference for a variety of information on less technical subjects. The structure of the J. Arthur Rank Orgn., past "Oscar" winners and data on 500 of the world's most popular films are among the 50 categories into which the book is divided. A. W.

SAFETY REGULATIONS IN KINEMAS AND THEATRES

A. F. Steel, A.M.I.E.E.*

Read to the B.K.S. Theatre Division on March 21, 1948.

FROM time to time public attention is drawn to the dangers inherent in kinemas and theatres by the news of a disaster involving many lives. In the minds of most people, the question of safety in a building is closely connected with fire, and it is from the aspect of precautions against fire that most legislation today has its origin.

The danger of fire is not limited to the actual burning of the building or the audience, but is more concerned with the resultant effects (*e.g.*, panic).

Site and Surroundings

The history of early theatres is almost completely linked up with their destruction by fire. Even today, especially in the older parts of some of our cities, the danger of the spread of fire from one building to another still exists (London, December, 1940). It is thus apparent that in order to maintain a reasonable immunity from the risks of fire, a building must be sited and constructed with an eye not only to its inherent risk, but also to its surroundings.

The first serious attempt in this country to deal with the danger of fires in theatres is probably the work—now a classic in its field—written by Captain E. M. Shaw of the London Fire Brigade (referred to in "*Iolanthe*"), first published in 1876.

Captain Shaw collected information regarding fires in theatres from all parts of the world, analysed it in the light of his own experiences, and formulated a scheme of theatre design and construction, which attempted to overcome or minimise the various sources of danger as near as they could be assessed at the time. The majority of his principles still hold today.

Preventative Measures

The basic problem of safety in kinemas and theatres is the same. In general, any assembly of people tends to be emotionally unstable, and can easily be stampeded into a form of panic or hysteria by any disturbance, no matter how trivial. All legislation in the interest of safety is directed in the first place towards avoiding the causes of disturbance. It is obvious that complete immunity from such forces is improbable, and the second problem of safety requirements is therefore directed towards limiting the evil results.

Of these safeguards, the principal one is that of giving quick and safe egress from all parts of the building. Causes of panic, apart from fires, are physical collapse of parts of the structure, failure of lighting, strange odours, sudden noises, etc., not to be anticipated in the type of entertainment.

Construction and Equipment

Due to modern methods of construction and control, the stability of the building is seldom in doubt. Latterly the Home Office has sought to introduce a new code of Regulations made under the Cinematograph Act, which has attempted to epitomize into mathematical formulae a standard of arrangement and construction suitable for application in all areas. It does not seem, however, that such a ready solution can easily be found.

A statement on broad principles, administered by experts, is much more

*Architects' Dept., London County Council

likely to produce the desirable result, and—since it can always be adapted to take account of new technical ideas—is much less likely to hamper development than a code set out in rigid but limited terms.

Methods of construction have so far progressed today that many theatres are as near as possible “fireproof”—as was evidenced in many instances during the recent war, where often the theatres and kinemas of modern construction stood in fire-stricken areas practically unscathed. The principal risks involved in the building are those introduced by its equipment.

No Smoking

Probably the commonest direct cause of fire is smoking. Except in a few theatres under the control of the Lord Chamberlain, smoking is generally permitted in any part accessible to the public. Many small fires and much damage to decorations and upholstery would be avoided if smoking were either prohibited altogether, or permitted only in specific small areas, as is the principle in America and elsewhere abroad.

Since it appears too late to legislate against smoking, the next best thing is to reduce its chances of producing serious fires. A carelessly thrown cigarette end can readily be fanned by the draught through a narrow crack so as to ignite even hardwood. It is essential, therefore, to eliminate narrow gaps that often exist between walls and floors, and also to reduce the chance of a cigarette end becoming lodged in a position where inflammable material may have accumulated, *e.g.*, “under floor” ventilation ducts.

Apart from smoking (and deliberate arson) there are few other causes of fire which can be directly caused by the audience, and the major part of legislation for the avoidance of fire and panic is now given over to control of the essential equipment installed. The chief of these are :—

- (a) the electrical installation ;
- (b) any other lighting installations, *e.g.*, gas, oil, battery and generating plant ;
- (c) the heating installation ;
- (d) the ventilation installation ;
- (e) the entertainment equipment, either kinematograph or stage (scenery, etc.) ;
- (f) organ ;
- (g) any other miscellaneous equipment provided for the comfort or service of the public, *e.g.*, lifts, kitchen and cookery equipment.

Electrical Installation

The electrical installation is of paramount importance in almost every type of place of entertainment. Many codes of regulations have been made to provide a reasonable standard of safety ; basically all are developed round two principal ideas—protection of the user from shock and the control of excess current due either to faults or overload.

In the earliest days of public electric supplies, voltages were generally of the order of 100, usually D.C., and the major part of the load was lighting. The shock risk, although realised, was of secondary consideration. As the demand for electricity increased, the supply authorities stepped up their distribution voltages ; the consequence was that the shock risk began to assume a greater importance than before. The protection against excess energy likewise became more difficult, and it is unfortunately probable that today the bulk of the legislation is due to the fact that at some time the view was taken that “law was cheaper than copper.”

With today's standard of 230 or 240 volts A.C.—with its resultant 400 or 415 volts between phases in a three-phase supply—shock risk for all users must necessarily be of prime importance, both for single- and three-phase work. As far as possible, the whole installation, including switches and controls, should preferably be inaccessible to the public.

The most usual type of installation, the conduit system, while possessing certain advantages in the form of a certain flexibility for renewals or extensions, unfortunately possesses the grave disadvantage that the bulk of the installation consists of empty space—particularly in the conduit itself—and the space invites the accumulation of moisture, usually introduced by the ordinary “breathing” of the installation under diurnal temperature fluctuation. The deterioration of V.I.R. cables in moist conditions is almost unavoidable, and it is unfortunate that the very quality—that of easy withdrawal and replacement of cables—that is regarded as an advantage in conduit work, is the principal reason for needing to utilise this attribute.

The only type of metal-clad wiring suitable for sub-circuit wiring that is generally considered as giving the requisite mechanical protection for use in places of public entertainment, mineral insulated hard metal sheathed cables (*e.g.*, “Pyrotenax”), is as yet not fully exploited. There appears now to be a likelihood of wider adoption of the system and it if can be encouraged, one of the principal risks of the initiation of fires will have been removed.

The wider use of high voltage luminous discharge tube lighting has brought its own set of problems—particularly in regard to the protection against faults of the high voltage side of the installation. The majority of troubles experienced so far in such installations, have necessarily been manifested on outside installations—usually as the result of weather conditions—and in positions where serious results have not usually occurred. The use of high voltage fluorescent lighting for interior installations has already commenced, and as its availability increases, a great extension of its use can be anticipated. So far the codes of the I.E.E. and the appropriate B.S. have appeared sufficient to provide an adequate standard of safety.

Power Transformers

A high voltage problem that has to be faced to an ever increasing extent is the installation of supply authorities' power transformers. Kinemas and theatres often provide the space for such equipment, usually at a most desirable spot in the distribution system.

Licensees should realise that by permitting this “cuckoo in the nest,” they introduce a serious risk into the building. Owing to the high voltages employed and enormous reserves of power in the form of the backing of the C.E.B. grid, the energy liable to be available in the event of a fault occurring is very large indeed. In many cases the fire risk is considerably magnified by the presence of oil for cooling or insulation purposes. Special precautions and limitations are suggested in a circular issued by the Home Office in respect of these installations. Up to the present a fault energy of 150 m.v.a. at 11 kv. represents the maximum that has been permitted, but it is possible that (at least as far as such an intensively developed area as the Central West End of London is concerned) these figures are liable to have to be exceeded, and new ideas on safety measures may need to be developed.

Another major problem requiring adequate consideration and control, is that associated with the supply authority's desire for balance over the multi-wired system (usually on three-phase). This necessitates the close proximity of different pieces of apparatus connected to different outer wires, with consequent high potential differences between such pieces of equipment. This is particularly noticeable on stages. For many years, some pretence of balancing portions of the stage lighting load has been made, *e.g.*, battens on one phase, footlights and front-of-house spot lamps on another, and dip circuits on the third phase.

Furthermore, owing to the demand for a large proportion of modern stage lighting load to be of a non-permanent nature, the liability for pieces of equipment connected to different phases being brought into proximity with

one another is greatly increased. Protection by earthing is essential, but this alone does not seem to be adequate.

The obvious first suggestion is that the whole of the stage lighting should be connected to one phase only, and balanced against the use of other phases in other positions. Such a balance would, however, be only nominal at the best. A better solution, which has been adopted in a few distribution areas, is to balance building against building. The only other alternative is to design three-phase equipment suitable for use by non-technical persons.

Emergency Lighting Systems

A problem usually associated with the electrical installations is that of the secondary or "emergency" lighting system, which in most premises of modern construction is by electricity. The principle adopted by many licensing authorities is that such a system should be completely independent of the main or primary system, and so installed that a fault on the one cannot affect the other. In the days when independent public systems of electricity were available, this involved separate intakes and wiring systems, but today the physical spacing of conduit systems is not usually required, although the actual wiring systems are kept separate.

In what are known generally as "trickle charged battery schemes," ("Keepalite") the light normally maintained is connected to the primary system, and is changed over only in an emergency. By some authorities this is regarded as a retrograde step, the safety of the system being dependent on the operation of a mechanical device, and approval has not yet always been given for the use of such a system. The system hitherto widely used and still encouraged in some areas—the floating battery system—has the advantage that even if all the devices to prevent feed-back between the battery and the source of charging current should fail, this merely adds to the load on the battery in an emergency—the safety lighting being certain of supply, even if only for a reduced period.

Many buildings, particularly old ones, are still provided with emergency lighting by gas, oil, or candle lamps. Gas installations have one great merit, not possessed by electrical installations—any leakage is at once noticed by the smell, usually before any serious results have developed. Precautions are necessary in the storage of oil and candles, while the use of ordinary paraffin is undesirable, owing to its comparatively low flash point.

Heating

The bulk of the heating on large premises is done by low temperature surfaces, *e.g.*, hot water, low pressure steam, or low temperature electrical elements, all save the last deriving the heat from equipment such as boilers installed in positions remote from where the heat is utilised. Where such plant is on the premises it is subject to its own set of safety regulations.

Most forms of electric heating require that the surfaces emitting the heat should have free access to air—any covering or obstruction to free convection causes the temperature to rise; even the so-called "low temperature" types readily reach red heat if the surface is lagged. Guarding is essential wherever the heating surfaces are liable to contact or interference.

Where the heating system is combined with ventilation, the considerations relating to surface temperature still apply, although in the case of electric heating, a higher input per unit volume of heating element is permissible, owing to the higher rate of dissipation of the heat used to the flow of air.

With regard to the requirements in boiler houses and generating plant chambers, the first consideration is that these should be structurally separated from the public portions, and it should not be possible for smoke from these chambers to reach the auditorium or ventilation system. Where oil

fuel is used, special risk is involved. Special precautions must be adopted to limit the flow of oil to boiler house level in the case of accident.

Ventilation

Ventilation is usually regarded primarily as a factor related to health and comfort, but there is also a safety aspect to be considered.

Where a safety curtain is provided, it is usually permissible to have scenery and properties. The ventilation of premises having such equipment must be arranged so that smoke and heat from the combustion of scenery cannot pass, either naturally or under the influence of the ventilation plant, towards the auditorium. To this end, means must be installed to ensure that there is always an up draught on the stage itself, and that the air in the auditorium is generally induced to flow towards the stage. "Downwards" systems of ventilation, *e.g.*, those with the fresh air introduced at high level and the vitiated air removed near floor level, often result in a tendency, at least near the stage end of the area level, for there to be a slight movement across the footlights towards the front seats.

One other aspect of ventilation that requires consideration from a safety angle is the necessity of keeping all incoming air free of contamination by smoke, offensive or noxious odours, etc. No matter how efficient any system of filtering which may be used, it is practically impossible for it to exclude all indrawn smoke or smell of burning from an auditorium. Nor must the system of filters have an inherent inflammability risk itself, and to that end fabric filters of ordinary combustible materials should be excluded—a casual spark from an external source could easily be fanned into a full blaze in such a position.

When refrigeration is employed, it is desirable either to employ an indirect system of cooling, *i.e.*, the air stream is not in direct contact with surfaces carrying the refrigerant, or, if this is not possible, to use a refrigerant which, in the event of leakage, is not toxic nor has an objectionable odour.

Celluloid Inflammability

The safety requirements introduced by the type of entertainment nearly always contain much of what has already been touched upon regarding the electrical installations, but each type of entertainment has its own special risks. The highly inflammable, almost explosive, nature of celluloid is well known, and the major portions of the Home Office codes, which derive their authority from the Celluloid Act, are devoted to safeguards in respect of this quality of inflammability.

Celluloid does not require free access to oxygen to cause combustion. Once the chemical action of burning has been started, enough heat is generated to release sufficient oxygen to allow decomposition to continue.

Under slow decomposition the celluloid gives off a large volume of choking gases, which are not only most objectionable to breathe, but also highly explosive. It would appear more desirable in a film fire to allow free access of air and to encourage rapid combustion, rather than risk offensive atmospheric conditions and the possibility of an explosion. Partially smothered film will not only leave the atmosphere in the enclosure in such a condition as to be most unpleasant for working for a long period, but also cause the deposit of condensed vapours of the volatile materials on all surfaces, making projection impossible until the equipment has been overhauled.

Stage or Platform

By many authorities, distinctions are made between a stage and a platform, both as to construction and the type of show that can be presented. In most

cases the term "stage" is limited to a premises equipped with a safety curtain. In such premises, assuming a minimum standard of construction, shows involving scenery made of inherently inflammable materials, such as timber and canvas, are permitted. Without a safety curtain, scenery is generally forbidden, and performances are of a limited character only.

A safety curtain is reckoned to stand up to conditions of a fire only for the few minutes necessary to enable all persons in the building to leave safely, but many curtains of modern construction have shown themselves capable of forming a really effective screen sufficient to prevent the spread of fire from one side to the other, even under extreme conditions; some even proved themselves able to provide a fair measure of protection against bomb blast.

Safety on a stage is also concerned with the direction of air flow in the ventilation system. To assist this upward flow on the stage, the whole of the stage portion is constructed rather like a flue, with openings at the top, normally closed only by light-weight glass set in frames to open on the operation of a fusible link. These precautions ensure that in the event of a fire among scenery, the heat and the smoke pass out at the top of the stage, and do not tend to reach the auditorium.

Stage Lighting

In view of the changes that are taking place in the technique of stage lighting, much of the old permanent lighting equipment is today often redundant. Good practice now seems to require a permanent switchboard, connected by suitably controlled permanently wired circuits to a large number of socket outlets disposed about the stage portion for the connection of whatever lighting equipment is used for each show. Canvas scenery, although treated to give "non-inflammability," is still inherently combustible, and it is essential that it should not come into contact with the high temperature surfaces of the stage lighting equipment. Lanterns and fittings are designed to run at relatively moderate temperature so long as there is free circulation of air around them, but it is quite easy for scenery and draping to become wrapped around the fitting.

Pipe Organs

Organs are so much a familiar piece of equipment in most kinemas today that they are apt to be disregarded as a potential source of danger. The all-electric organ has no special risk other than that associated with electrical equipment generally, but a pipe organ has an inherent high fire risk.

It is very largely built of soft wood. It is essential, in order to keep the instrument in tune, to maintain the interior of the organ at a relatively high temperature in order to exclude moisture, with the consequence that the timber is in a very dry state. In addition, the whole of the interior of the organ is generally a mass of poorly insulated wiring, not easy to protect against fault or flame. In the operation of the organ a current of air is forced through the wooden portions in such a way that a casual spark can be fanned into a blaze.

The organ is usually erected in chambers, which are shut off by special louvred shutters of fire resisting construction, held open by fusible links, which on causing the shutters to close, simultaneously open a vent to the outside air, so that any smoke or flame is led away from the auditorium.

Miscellaneous Equipment

The miscellaneous equipment in a kinema or theatre includes such items as cooking appliances, ice-cream refrigerators, soda fountains and lifts. They require the same general consideration as any other apparatus.

Refrigerators require special consideration, both as to the type of refrigerant and to the method of defrosting and other essential maintenance. Lifts are required to be subject to inspection by a special branch of the insurance business, who certify as to the safe condition of the equipment under their care. There are accepted standards of safety regarding loading, interlocking of doors and controls, type of gates and doors, etc.

Conclusion

It is hoped that sufficient has been said to show that safety requirements are not necessarily a manifestation of a desire on the part of the authorities to be officious, but arise genuinely out of the necessity to apply acquired experience to the problem of reducing, as far as practicable, the calculated risks brought about by the congregation of large numbers of people. In general, the authorities work on the principle that "Prevention is better than cure."

As to whether these requirements should be administered through the authority of a body advised by skilled and specially trained technical staff, or by the mandatory power of an individual working to a rigid and often imperfectly understood code, definite views will be held by the licensees according to their experience under these two extreme systems. The opinion cannot readily be avoided that the first is the more likely to achieve the desired results with a minimum of anomalies.

DISCUSSION

Mr. R. H. CRICKS: Has Mr. Steel any suggestions for improving the standard of inspection throughout the country?

THE AUTHOR: I feel that the majority of modern projection rooms are, by virtue of their construction and equipment, safe to the degree that whatever may happen will not affect the audience. There is one fundamental factor that contributes to safety—the full attention of a skilled projectionist continuously on the job.

Mr. S. C. WILLIAMS: Do you consider the use of fluorescent lighting in projection rooms is an addition to the fire risks?

THE AUTHOR: Low-voltage lighting I do not regard as a great risk. The starting equipment is a small item of additional equipment.

Mr. W. V. DEWAN: Where do you suggest is the best position for the projection room?

THE AUTHOR: From a technical point of view, a box with a level line of sight should be preferred. On the other hand, from the constructional angle, it is often easier to provide proper entries at roof level.

Mr. S. C. WILLIAMS: You mentioned the fire risks of the stage and auditorium, but personally I feel the greatest risk is in the roof void.

THE AUTHOR: The biggest risk associated with the roof void, apart from the storage of rubbish there, is the carelessness of those responsible for maintenance

due to dropping of cigarettes and matches.

Mr. R. H. CRICKS: In America it is required that in the event of a fire, a fusible link shall close the ventilating means of the projection room, while in this country we insist upon providing added ventilation by means of windows, which can be broken by an explosion. Can Mr. Steel account for this disparity?

THE AUTHOR: We have had explosions due to an accumulation of the vapours of partially burnt celluloid. With an outlet operated by a fusible link, you have sufficient outlet for the vapours.

Mr. L. W. J. HENTON: In America, owing to the climatic conditions, they mostly provide air-conditioning for the boxes; they allow them to connect that directly to the theatre system. If they had no system of shutters, smoke might work back to the auditorium. In this country, it is legislated that we must not connect the box to the theatre ventilation.

Mr. W. V. DEWAN: What type of fire extinguisher do you favour, the C.T.C. type?

THE AUTHOR: C.T.C. extinguishers produce toxic effects under certain conditions, but personally I think the danger has been over-drawn.

Mr. F. H. SHERIDAN-SHAW: What is the requirement for maintained lighting?

THE AUTHOR: The regulations in London contain a clause calling for .025 foot-candle.

LIGHT PRODUCTION FROM THE CARBON ARC

H. P. Woods, B.Sc., A.Inst.P., M.B.K.S.*

Summary of paper read to the B.K.S. Manchester Section on March 2, 1948.

THE present paper is confined to carbon arcs for kinematograph projection, and is intended to illustrate the fundamental differences between the different types, their development and limitations of use.

Assessment of Carbons

Although much development and research is done under practical conditions of burning, it is obvious that to secure a true standardisation and knowledge of the light production by the arc, measurements must be made at the arc crater itself in some standard units. The "Intrinsic Brilliancy" is a measure of the brightness of the crater, specified in International candles/mm.². The brightness of the crater is usually examined by throwing an enlarged image of the crater on to a screen by means of a lens; further measurements are made by means of a standard flicker photometer, which compares the candle-power of the arc with that of a calibrated tungsten lamp of known candle-power.

Recommended standards of screen brightness have now been established, both in this country and in America. The limits in both countries are very similar, the British Standard being 8-16 foot-lamberts at the centre of the screen, with the projector running and no film in the gate¹. Assuming, for practical purposes, a relatively new screen with a reflection factor of 0.7, it would be necessary to have 8/7, i.e., 11.4 foot-candles, on the centre of the screen to achieve the *lower* limit of screen brightness. It is obvious that an illumination in the region of 15 foot-candles should be available to allow for fog, smoke and screen deterioration. To produce the minimum level of illumination recommended for a 25-foot picture some 4,400 lumens are required.

Straight Arc with Condenser

One of the original arcs used for film projection was the so-called "Straight Arc." Although for larger carbons the arc current was increased to currents of the order of 100 ampères or more, the current density, and hence the I.B., remained the same for all sizes of positives. In consequence, the larger carbons produced a greater coverage of the film aperture without much increase in screen illumination.

Low-Intensity Mirror Arcs

With the introduction of the elliptical mirror with its larger angle of collection of arc light, the straight arc was superseded by the mirror arc as used today. The electrode sizes were considerably reduced, at the same time the current required was much smaller, 20-40 ampères, and a brighter and more easily controlled light resulted on the screen.

The main source of light is the glowing crater, which is slightly concave in shape. The crater itself produces about 90% of the total light; examination of the I.B. of the crater shows that the brilliancy is practically uniform over the surface, and that the mean brilliancy increases gradually with increase of current, and reaches a maximum brightness of the order of 200 CP/mm.² on all sizes of positives. A relatively flat distribution of screen light is produced.

*Ship Carbon Co., Ltd,

An important point in favour of the larger carbon, is that a larger crater has the advantage that it may be moved out of its focal position to a greater extent than a smaller crater before it produces the same change in screen illumination. This is illustrated in Fig. 1 which shows the total screen light produced by a 10mm. and a 14mm. positive when they are moved from the focal point for maximum light.

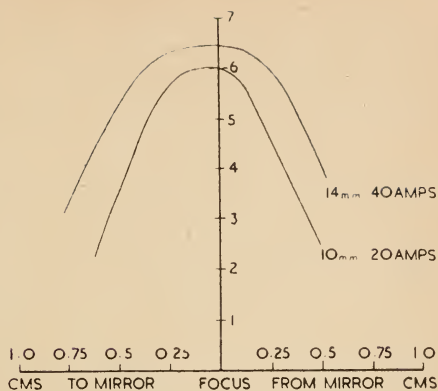


Fig. 1. Variation of Screen Light with Movement from Focal Position.

High-Intensity Arcs

With the introduction of rare earths into the core of the positive electrode, it is observed that the character of the carbon arc is changed. In the first place, if the conduction of current to the arc and crater is assisted by a front contact just behind the crater, or by a copper coating on the electrode itself, much greater current densities can be given to the carbons. As the current density is increased, instead of the shallow crater typical of the L.I. positive, a deeper crater is developed. Within this crater the rare earths in the core are vaporised, filling the crater and streaming outwards and upwards from it in the form of a core flame of great intensity.

It is further observed that on increasing the current density the arc no longer hisses, and that signs of overload become apparent only at a current density well above that of the L.I. arc.

The rotation of the positive carbon maintains a uniform circular presentation of the crater to the condensers. The rotating positive H.I. arc with a front contact through which the current is conducted just behind the positive crater was one of the original H.I. arcs for kinematograph use.

The crater light is collected by means of two condenser lenses of heat resisting glass placed approximately 5 inches from the crater.

Fig. 2 shows the distribution of brightness

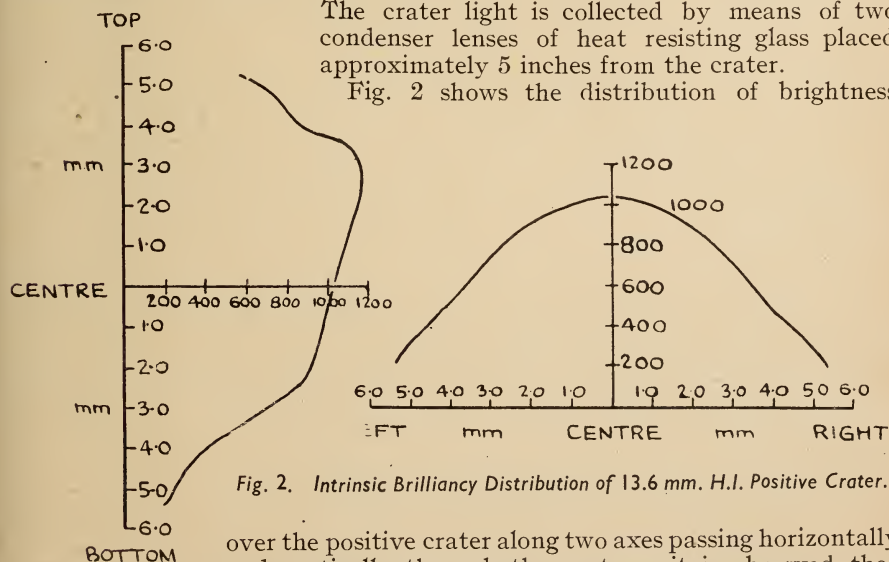


Fig. 2. Intrinsic Brilliancy Distribution of 13.6 mm. H.I. Positive Crater.

over the positive crater along two axes passing horizontally and vertically through the centre; it is observed that the crater brightness has been increased four-fold over that of the brightest L.I. trim.

Although this type of arc has been gradually replaced by the smaller copper coated H.I. carbons in the large mirror arc lamps, developments in the past few years in which water-cooled silver jaws have been used, enabling higher current densities and arc wattages to be applied to the carbons, have resulted in the production of much higher intrinsic brilliance of the crater².

Small Copper-coated Super-loaded H.I. Arcs

One of the most popular types of H.I. arcs in use today, is the arc in which small copper-coated electrodes are horizontally opposed, and burnt at a high current density and low arc-voltage with a short arc-gap. A crater brightness some 2 to 3 times that of L.I. carbons is produced and a positive burning rate up to 14ins. per hour is obtained.

This arc, in conjunction with an elliptical mirror of large collecting angle, and a projection lens having a wide aperture, produces a screen light ranging to 5,000 lumens, which is capable of illuminating large screens to the recommended standard. The fast burning rate of the carbons necessitates an automatic feed.

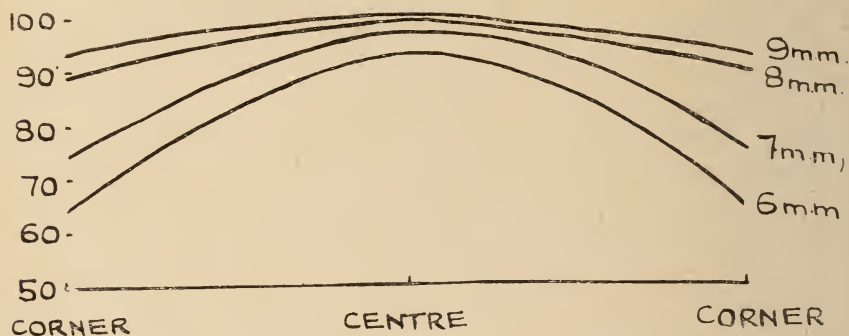


Fig. 3. Distribution of Screen Light from different sizes of H.I. Positives.

In this smaller range of trims, advantages are gained in increasing positive size, although at the maximum current the 7mm. carbons produce a light not far short of that of the 8mm. trim. Another point to notice is the rapid increase of light with current, a difference of 3 ampères on the 7mm. trim, for example, making 15% change in screen illumination. Fig. 3 illustrates the difference of screen distribution for the three trims at maximum ampèreage.

A.C. Arcs

The H.I. A.C. arc, consisting of two specially designed copper-coated electrodes of a similar character, burning horizontally on an alternating supply from a single-phase transformer, has achieved great popularity in this country during the last eight years, and is now firmly established as a satisfactory source of illumination for film projection in medium sized kinemas.

There are two main advantages of the A.C. arc, viz :—

1. Simplicity of automatic feeding, due to the equal burning rate of both carbons.
2. Conversion equipment being small and simple in operation and maintenance.

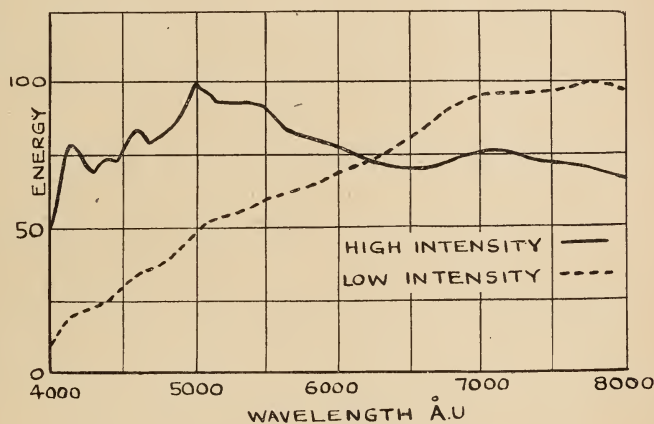
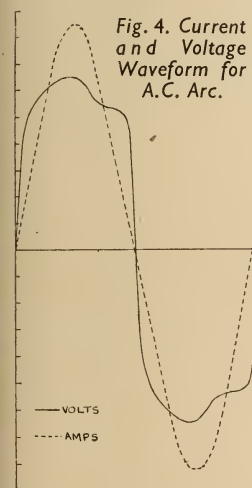
At the same time the A.C. arc produces a white light of similar colour to the normal D.C. H.I. arc, and the burning rate of the carbons, 4.5-5.0ins. an hour, is quite economical.

The arc itself is quite different in appearance from the normal H.I. arc. On the ends of both electrodes are formed two shallow craters from which project two small core flames. Two tail flames are produced, which cross symmetrically when the carbons are properly aligned. Between the two craters the arc flame is bluish-white in appearance, and has a much lower luminosity, about 130 CP/mm.², than either of the craters, which have a maximum value of the order of 380 CP/mm.², and an average value over the whole crater of about 350 CP/mm.². In general, only one crater is used as the source of light, optical collection by an elliptical mirror being applied as with the D.C. arc crater.

A point of interest concerning the A.C. arc is the wave form of the arc current and voltage, as in Fig. 4, which shows that the current wave is sinusoidal, but the voltage wave on the other hand is distorted. If the arc volts and current are together applied to the oscillograph, it is seen that they are in phase; due, however, to the voltage wave distortion, a power factor of the order of 0.94 is produced at the arc.

Colour of Light

The question of the colour of the light emission of the carbon arc in its many forms has been the object of much research and measurement by



many workers in the field of carbon arcs³. Two typical curves obtained for a L.I. and a H.I. trim of carbons are shown in Fig. 5. An examination shows that there are fundamental differences between the two arcs. In the case of the L.I. arc, the curve is reasonably smooth, with maximum energy in the region of 8000 Å. in the infra-red region. The energy curve for the H.I. light on the other hand, although continuous, has certain peaks, the highest lying in the green region at 5000Å.; it is obvious that this light, having its main energy lying in the visible region between 4000 and 7000Å., is more efficient from the projection standpoint, since any energy beyond the visible region limits does not produce screen light but only heats the film and gate. The H.I. light must in consequence be relatively cooler than the L.I.

REFERENCES

1. British Standard 1404, 1947.
2. *J. Soc. Mot. Pic. Eng.*, Jones, Zavesky and Lozier. Vol. 45. Dec., 1945.
3. *J. Soc. Mot. Pic. Eng.*, Null, Lozier and Joy. Vol. 38. March, 1942.

TECHNICAL ABSTRACTS

Most of the periodicals here abstracted may be seen in the Society's Library

IT STARTED 25 YEARS AGO.

R. H. Cricks, *Sub-Standard Film*, May 1948, p. 5.

The history of the sub-standard film is traced, from the introduction by Eastman Kodak, in 1923, of the 16mm. film. Future developments, it is suggested, demand the perfection of the non-intermittent projector; quantity production of prints could be cheapened by the use of the imbibition process.

AUTHOR'S ABSTRACT.

"DANCING TRIPOD" FOR FOLLOWING CLOSE-UPS.

Frank Planer, *Amer. Cinematographer*, May, 1948, p. 151.

A camera support for facilitating close-ups of moving characters, consists of a metal ring 6ft. in diameter, mounted on casters, having one bracket which is attached to the actor, and another which carries the camera, an Eyemo being preferred.

R. H. C.

HIGH-SPEED MOTION PICTURES WITH SYNCHRONISED MULTIFLASH LIGHTING.

R. A. Anderson and W. T. Whelan, *J. Soc. Mot. Pic. Eng.*, March, 1948., p. 199.

To secure better resolution of fast moving subjects when photographed with a high-speed motion picture camera, a short duration high intensity flash discharge tube is synchronised with each exposure. The camera used was a 16mm. rotating-prism type and synchronisation was accomplished by a brush-type contactor built into the camera. Resolving power tests were made at a camera speed of 1800 pictures per second by photographing a disc 1 ft. in diameter, revolving at 1500 revolutions per minute. By the use of flash lighting it is claimed that the resolving power is doubled for a rapidly moving object, and increased by 25% for a stationary object.

R. McV. W.

SOUND FILM RECORDING.

Dr. Klaus Jungk, *Foto-Kino-Technik*, April, 1948, p. 101.

The author stresses the point that sound and picture should be taken under the same perspective; this really means that the best position for the microphone would be on top of the camera. He then gives a few experiences and describes the best arrangement of an orchestra for sound recording, the best reverberation times, the effect of non-directional and directional microphones and the regulation of the sound volume and mixing for transition from one scene to another. The desirability for close co-operation between director, camera-man, sound-recordist and cutter is also emphasised.

O. K. K.

A CONDENSER-MICROPHONE FOR STEREOPHONY.

A. Rademakers, *Philips Tech. Rev.*, Vol. 9, No. 11, p. 330.

The design and constructional details of a miniature condenser microphone of outstanding performance are given, and the many factors governing the mechanical and electrical parameters are clearly dealt with.

N. L.

WOW METER FOR TURNTABLE TESTING.

E. W. Pappenfus and G. L. Sansbury, *Electronics*, Mar., 1948, p. 108.

The turntable to be tested is arranged to generate an audio voltage by mounting upon it an accurately centred toothed wheel. Two magnetic pick-up units are placed in the field of the metal teeth, one on each side of the turntable, and their coils are connected in series. The voltage generated in the coils is amplified and passed first to a limiter and then to a discriminator, whereby frequency fluctuations are indicated on a centre zero meter. Methods of setting up and calibrating the instrument are described and reliable readings down to 0.1% are claimed.

N. L.

WORD SPOTTING ON MAGNETOPHONE TAPE.

H. Gunka and W. Lippert, *Funk und Ton*, March, 1948, p. 125.

Apparatus enabling sound passages and single words on a length of Magnetophone tape to be located with great accuracy consists of an additional device for use with the standard Magnetophone. The tape is fed from the Magnetophone round the periphery of a large

circular ring within which a rotating magnetic pick-up head is disposed. The rotating pick-up head is connected by slip rings to the input of an amplifier which feeds a loud-speaker. The desired passage on the tape can be cut or marked with a coloured pencil as the tape is running through the machine, or cut after the whole reel has passed through.

O. K. K.

S.M.P.E. WORK ON SCREEN BRIGHTNESS—REPORT OF COMMITTEE.

J. Soc. Mot. Pic. Eng., March, 1948, pp. 254, 260.

The long-term programme of the S.M.P.E. Screen Brightness Committee is to determine present practice, evaluate the efficiency of existing equipment, and fix standards of brightness and methods of measurement. The Committee correlated data relating to 40 projectors installed in 18 theatres. It was found that 50% of theatres had a screen brightness at or below the minimum recommended of 9 foot-lamberts. The readings showed that in the majority of cases, the efficiency of both projectors and screens was considerably below that obtainable under laboratory conditions.

R. H. C.

PRESENT POSITION AND FUTURE SCOPE OF STEREOSCOPIC FILMS.

W. Sells, *Foto-Kino-Technik*, April, 1948, p. 95.

A review of stereoscopic systems includes the complementary colour system; the anaglyph system; the system using polarised light; the synchronous shutter system (using spectacles or blinkers); and the lenticular film and line screen systems.

The author reports a very interesting proposal by Schenk, to use a system analogous to electron optics for producing a massless line screen of ultra-sonic standing waves. This is done by placing a trough made of two spaced parallel glass sheets in front of the screen: the trough is filled with a suitable medium and ultra-sonic standing waves are produced in this medium, thereby creating a massless lenticulated element.

Brief mention is also made of a multi-lenticular system in which the optical elements used are arranged not only in parallel lines but also in height so that a stereoscopic effect is obtained vertically as well as laterally.

A graphical illustration is also given of the amount of distortion encountered at each different seat in the auditorium when stereoscopic films are projected. It is the author's opinion that, in view of this distortion, the only use for stereoscopic films is in the field of instructional, technical and medical films.

O. K. K.

THE COUNCIL

Meeting of September 1st, 1948

Present: Messrs. W. M. Harcourt (*President*), A. W. Watkins (*Vice-President*), E. Oram (*Hon. Secretary*), C. H. Champion, B. Honri, H. S. Hind, F. G. Gunn, R. B. Hartley, R. E. Pulman, R. H. Cricks (*Technical Consultant*), W. L. Bevir (*Secretary*), and Miss S. M. Barlow (*Assistant Secretary*).

Holidays—In view of the holiday season it was agreed that the meetings of the Council and the Executive and Finance Committees should be coalesced.

Patron Membership.—It was reported that Messrs. Technicolor, Ltd., had agreed to become Patron Members of the Society.

Hon. Treasurer.—Mr. P. H. Bastie's desire to resign as Hon. Treasurer was received with regret, but his offer to continue in office until April, 1950, would be considered at a future Council meeting.

Papers Committee.—It was reported that the 1948 lecture programme had been finalised and a few confirmations were awaited for that of 1949.

Education Committee.—Consideration of the appointment of an Education Officer and proposals for lecture courses was deferred until after the next meeting of F.I.T.A.C., to await a report from the President.

Film Speed.—It was agreed on the request of the Theatre Division Committee, that a proposal from Czechoslovakia to increase film speed to 25 frames per second should be referred to the B.S.I.

Library Committee.—Mr. Rex Hartley reported that the new Library Catalogue was nearing completion and there were hopes of sending it out at the end of September.

Stewards.—One member of Council would be among the stewards for the reading of each paper.

B.S.I.—It was agreed that Messrs. Cricks, Hind and Pratt should represent the Society on the B.S.I. Committee on 16mm. projectors.

Italian Co-operation.—Exchange of information and hospitality with the Associazione Tecnica Italiana per la Cinematografia was referred to the Foreign Relations Committee.

LECTURE PROGRAMME

November, 1948

Meetings to be held at the Gaumont-British Theatre, Film House, Wardour Street, London, W.1, commencing at 7.15 p.m., Sundays, 11 a.m. Sub-Standard meetings in the G.-B. Small Theatre.

T—Theatre Division.

S—Sub-Standard Film Division.

A—Joint Meeting with A.C.T.

Nov. 3 **"LENS MANUFACTURE AND RECENT OPTICAL DEVELOPMENTS,"** by A. HOWARD ANSTIS, A.Inst.P., M.B.K.S., A.R.P.S.

S Nov. 10 **"Industrial Newsreels,"** by Dr. N. BEESE and S. BOYLE, F.R.P.S.

T Nov. 21 **Modern Kinema Equipment: I—G.K.21 Projector,** preceded by a film "Let Us See," by courtesy of the Illuminating Engineering Society.

A Nov. 24 **"Filming the XIVth Olympiad—Production Problems and Technical Aspects,"** by L. CASTLETON KNIGHT.

MANCHESTER SECTION.

Nov. 2 **Technical Visit to Salford Electric Instrument Co., Ltd.**

Silk Street Works, Salford. Members meet at 10.15 a.m. at Salford Royal Hospital, proceed to works 10.30 a.m. Admittance by invitation card only, from Secretary.

NEWCASTLE-ON-TYNE SECTION.

Meeting to be held at the Lecture Theatre, Newe House, Pilgrim Street, Newcastle-on-Tyne, 1, commencing at 10.30 a.m.

Nov. 2 **"Meters and their Readings,"** by D. H. THOMAS, M.Sc., A.M.I.E.E.

LEEDS SECTION.

Meeting to be held at the Y.W.C.A., Cookridge Street, Leeds, 1, commencing at 10.30 a.m.

Nov. 6 **"Auditorium Requirements in Sound-Film Presentation: Part I—Picture Projection,"** by R. PULMAN, F.B.K.S.

BRITISH FILM ACADEMY.

Invitations may be obtained from the B.K.S. for the following meeting, to be held at the Gaumont-British Theatre at 8.30 p.m.

Nov. 5 **Address by Retiring Chairman, DAVID LEAN.**

Requests from non-Members for invitations to the above meetings should be accompanied by stamped addressed envelope.

INTERNATIONAL COMMISSION ON ILLUMINATION

Recommendations of the International Commission on Illumination, held in Paris this summer, called for studies of auditorium lighting, colour filters and lighting and fluorescent materials, and types of kinema screens in use; and recommended

the general use of an instrument to measure screen brightness.

A British report on Theatre Lighting dealt mainly with light sources and control equipment. It recommended that pre-focus caps and holders be adopted universally.

PERSONAL NEWS of MEMBERS

Members are urged to keep their fellow members conversant with their activities through the medium of British Kinematography.

T. E. A. BURROWES has left 20th Century-Fox to start his own business in Glasgow, a 16mm. film library agency.

D. CHATTERJEE is directing "Avispata," ("The Cursed"), the maiden venture of the Kalpataru picture company, which is being produced in Calcutta.

DENIS WARD is now Managing Director of a newly formed Company, Technical and Scientific Films, Ltd., in association with the Film Producers' Guild.

ERIC ("BUNGAY") WILLIAMS, formerly chief engineer at Ealing Studios, has been on a visit from Australia to this country to consult on future production plans. He hopes, in co-operation with A. J. Williamson, to inaugurate a B.K.S. branch in Australia.

ALAN J. WILLIAMSON, B.K.S. Australasian representative, has just celebrated the completion of fifty years in the film industry, in which he started in his father's studio at Brighton.

SYDNEY HART and S. B. SWINGLER are Joint Engineering Controllers of the Engineering Maintenance Dept. of the Cinema Management Assn., which combines the control of Odeon and Gaumont-British; R. R. PULMAN is projection engineer and J. M. CARSON sound engineer, and H. E. WHITNEY is in charge of heating and ventilating.

Small announcements will be accepted from Members and Associates. Rate, 4d. per word, plus 2s. for Box No. if required (except for Situations Wanted). Trade advertisements, other than Situations Vacant, not accepted.



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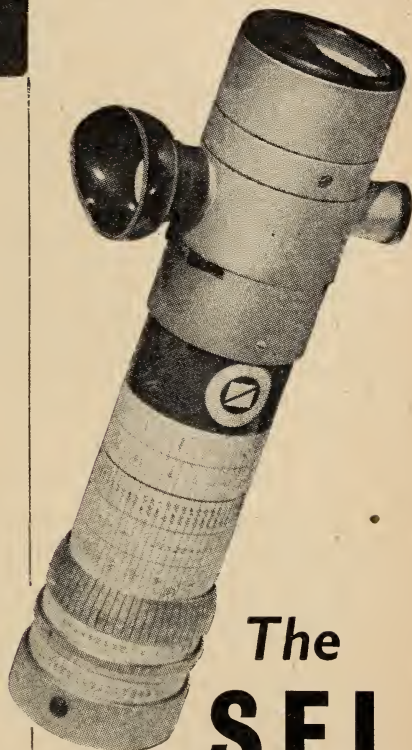
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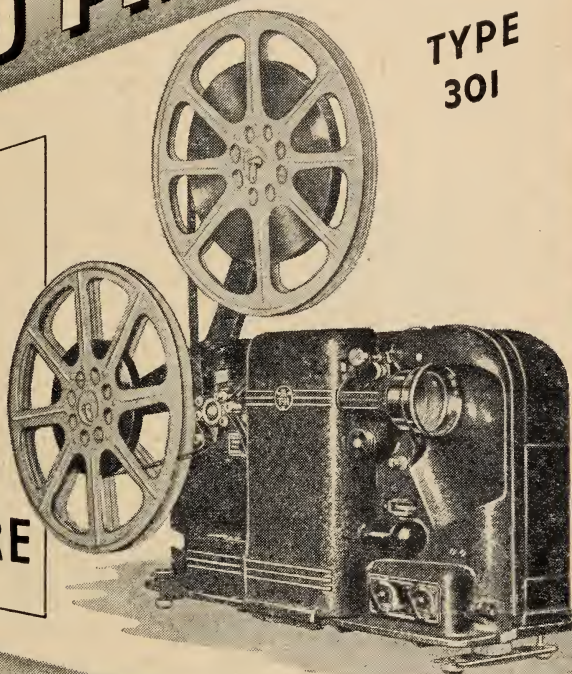


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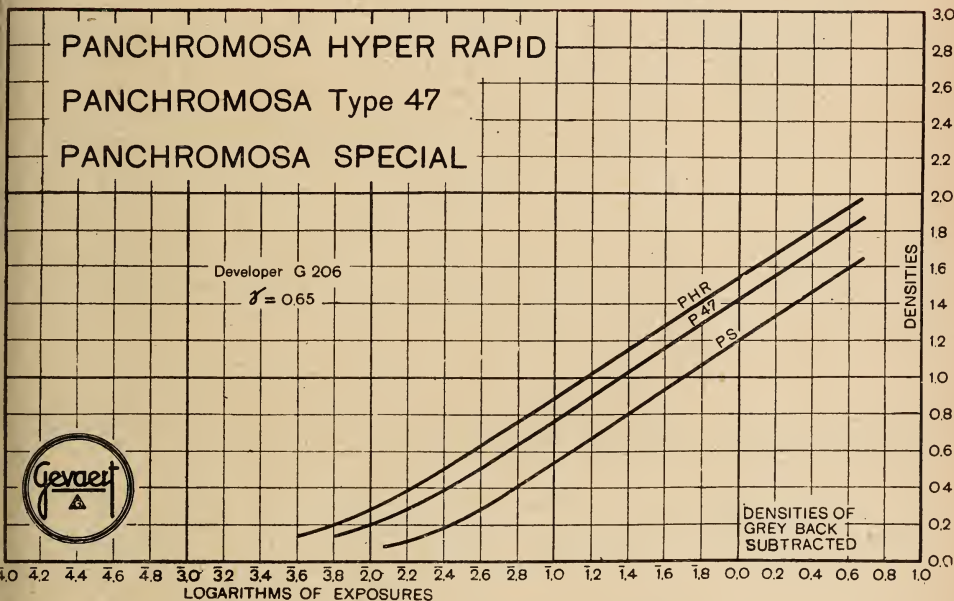
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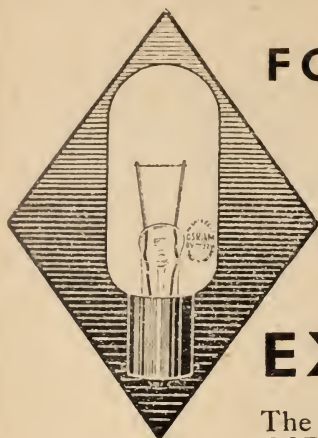
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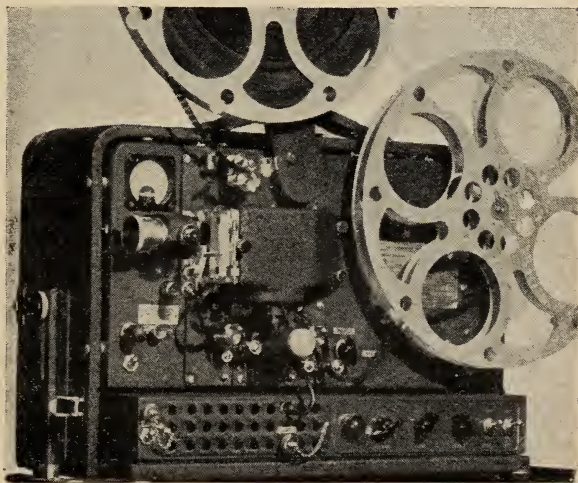
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BRITISH KINEMATOGRAPHY

The Journal of the British Kinematograph Society

VOLUME THIRTEEN, No. 5.

NOVEMBER, 1948

DESIGN AND USE OF THE MINIATURE IN MOTION PICTURE PRODUCTION

John Bryan*

Address delivered to a joint meeting of the British Kinematograph Society and the Association of Cine-Technicians on March 3, 1948.

MINIATURE work is included in that class of film production known as process work. One of the main reasons for the use of process shots is economy. It is possible through the use of these shots to produce illusions of vast palaces and buildings, scenes out of the past, special lighting effects, etc., which give a great production value to the picture for the minimum cost.

The Art Director also finds that he can preserve the design of his sets. By the use of miniatures he can portray a set exactly as he visualises it.

Process Shots

The image on the film may have originated from a photographic enlargement, a model set, a hanging miniature or, in its simplest form, the hanging of a painting in front of the camera. The most important thing to remember is that the area above the movement of the actors in the full-size set can be treated by any of the methods stated above. For example: the designer is required to build a ball-room setting. Having decided his camera angle, he makes, in miniature, the section of the ballroom that will appear above the heads of the actors, *i.e.*, the walls, ceiling, chandeliers and lighting effects, etc. This miniature may then be placed at any point on a line from the lens to the section of the full-size set covering the heads of the actors.

Methods of Shooting

There are two ways in which these hanging miniatures can be shot. First, the miniature can be photographed simultaneously with the set. This is advantageous inasmuch as the cameraman is then able to light the miniature and the set at the same time and be sure of getting a perfect lighting match. The disadvantage of this method is that owing to shortage of studio space, the settings have to be built very quickly, and there is seldom time for the complicated process of joining the miniature to the full-size section of set.

This difficulty has been overcome by matting the section of the set to be covered by the miniature, and then at a later date shooting the miniature section in the Special Effects Department. Of course, this is a much more complicated method and requires a great number of tests to be made.†

The third method of using the miniature, though not so widely used today,

*Independent Producers, Ltd.

†See *Brit. Kine.*, Sept. 1948, p. 74.



Fig. 1. Fagin's Bridge from "Oliver Twist"—the Art Director's Design and the completed Scene. On the right is shown the only portion of the Scene that was built full-size, the remainder being Miniatures, with a Painted Backing.

is the Schüfftan process.* This method employs a mirror placed before the camera lens at an angle of 45° , reflecting the model or miniature set into the lens. The mirror backing covering the section of full-sized set required for the movement of the actors is removed, the lens then photographing the reflection of the model and the full-sized set simultaneously.

Model Sets

In the preparation of a process shot, the Art Director's drawing is first projected in perspective, and from this projection plans and elevations are created. The whole set is drawn up as though it were to be built in full scale. In conjunction with the Special Effects Department, the decision is taken as to where the miniature shall begin, based upon the action required—i.e., what proportion of the set need be built full-size and what proportion in miniature.

For example: in the set of Fagin's Bridge in "Oliver Twist" (Fig. 1), the only portion built full scale was the bridge across the street over which the actors had to pass. The remainder was matted out, and later the adjoining portion of the houses and the nearer roof-tops were built as a small model. The more distant roofs and sky backing were painted. Between the sky and the painting the dome of St. Paul's was built as a miniature, so that we could obtain the effect of the sun striking it.

Another example is the ballroom scene from "Great Expectations" (Fig. 2). In this case, everything above the heads of the actors was miniature, including the chandeliers which were specially made in Perspex, the lights being pin bulbs.

Special Effects

Amongst the effects which cannot be reduced in scale are fire and smoke. The scene from "Caesar and Cleopatra" (Fig. 4), showing the burning of the library was therefore reproduced by placing the fires at a calculated distance behind the model—the flames and smoke appearing above the model in their correct perspective. The Market-Place consisted almost entirely of

*See *Brit. Kine.*, July 1943, p. 91.



Fig. 2. Ballroom Scene from "Great Expectations." The Ceiling and Chandeliers were Miniatures.

miniatures—a term which should not be taken too literally as some of the models were thirty feet in length !

A particularly interesting example of the effects of model sets occurred in a war-time film on which I was Art Director : "The Adventures of Tartu" (Fig. 3). The sequence was set in a poison-gas factory. For the scenes required, a complete model of the plant, 18 feet high and 30 feet long, was built. From this model, all the back-projection plates, photographic backings and matte shots were prepared. Most of the scenes were then shot in the studio using these effects.

Certain scenes, however, called for a very high camera view-point. We were able, for these, to use the Wembley Stadium, where we placed the camera in the roof and shot through photographic backings prepared from the model. Some of these shots called for an unusual combination of various processes ; all of them embodied a very small portion of the full-sized set, and photographic backings or matte shots were used for the remainder of the picture.

Outdoor Scenes

It is possible for the Art Director today to use model shots for the design of a whole sequence. For instance, the opening scene of "Oliver Twist" (Fig. 5), shows a girl climbing and stumbling over a rough hillside. She is in pain, and the Director wished to have a background to accentuate this. Therefore, he desired a thunder-storm ; across the sky can be seen the rising storm clouds, and the girl is buffeted by wind and soaked by the drenching rain. It was decided that it was useless to try and find an actual location, because even if we found one it would have meant a camera unit staying

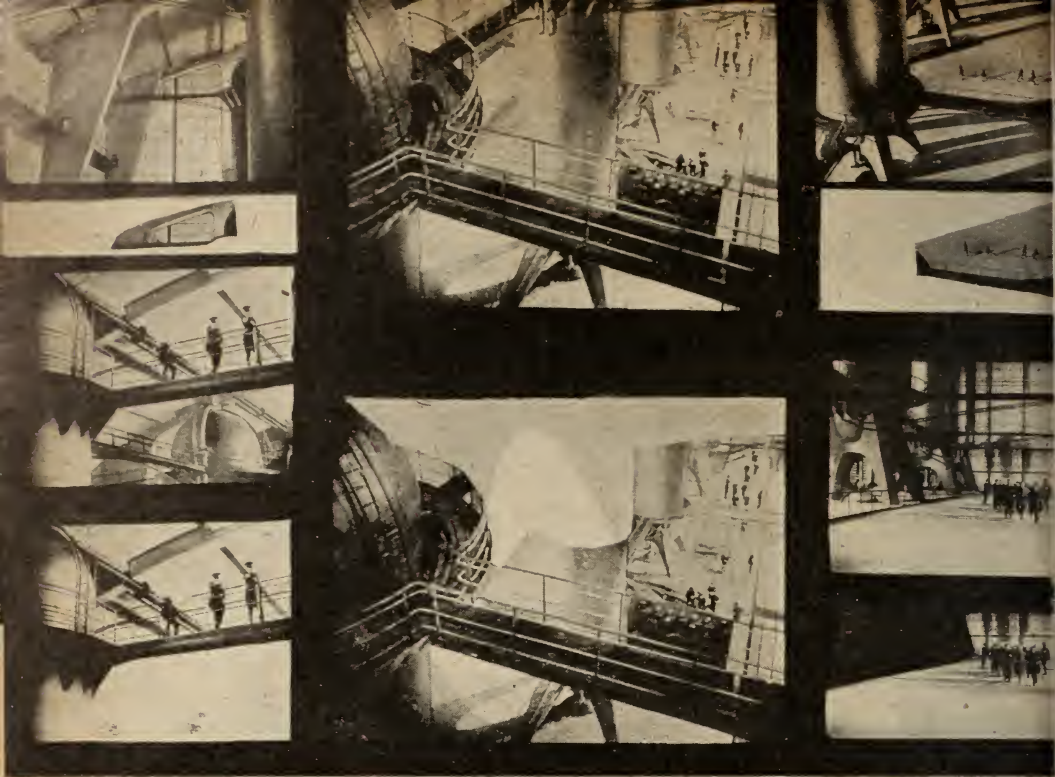


Fig. 3. Scenes from "The Adventures of Tartu," which were filmed against Backings photographed from a Model Set. Below each Scene is shown the portion built full scale, including photographic backings.

there until a storm occurred, and then the clouds would probably have gone in the wrong direction.

I produced a series of action sketches covering the whole sequence ; these were agreed with the Director and from them we set about producing the desired effects. After a great deal of experiment, the Special Effects Department at Pinewood found that they could achieve the effect of the storm clouds by the use of cotton wool applied in the desired shapes upon sheets of glass. The glasses, which were set in series, were then motivated by mechanical means in the required direction. The resultant film of these clouds was then used for back-projection plates and matte shots. The rain effects in this sequence were produced in the same way.

Camera Equipment

An obvious difficulty arises in any shot combining a miniature and full-size set when it is desired to move the camera. It will be realised that, to avoid relative displacement of the miniature and the full-size background, the axis of the camera movement must coincide with the nodal point of the lens. The normal fitting for the cameras does not allow for this, and a special fitting has been made for this which is known as the nodal head. This allows for horizontal and vertical movement of the camera, keeping the relative position of the miniature and the full-size background in their correct perspective.

One of the difficulties I have encountered in the reproduction of my designs on to the screen is the translation of my sketch into a three-dimensional background when a large area of the picture is to be matted. It is very difficult to reproduce in the studios a small section of a set and be sure that the architectural composition, when seen as a whole with the matte process, will be similar to the original design. To overcome this, I have my sketch photographed and then printed on negative stock—and by placing a frame

of this negative in the gate of the camera I am able to make certain that the main lines of the sketch are carried through in the section of the full-size set required to cover the action.

I am a great believer in the importance of ceilings when showing on the screen a long shot of any interior. They complete the design and add reality. It will be realised that it is quite impossible to cover the full size of the set as the cameraman will have nowhere to put the lamps required for the lighting. By the use, however, of a hanging miniature of the ceiling required placed at the correct distance from the lens, it is possible for the cameraman to have his lights around the top of a full-size section of the set and carry out his normal lighting procedure.

Departmental Co-operation

In conclusion, I would like to stress the importance of the Director's co-operation with the Art Director when a hanging miniature of any sort is required. The process of making these miniatures and the setting up of them in their correct position is often a long and complicated job, and once the scale and position has been decided, it is not possible, without a great deal of reconstruction and loss of time, to change it. You will see, therefore, that it is essential that the Director and the Art Director agree on the exact position and design of the shot before any work is commenced.

I have been very fortunate in the last two years in working with a Director and cameraman who are very knowledgeable about this section of the industry, and once we decide between us the exact composition of the shot, I am able, with complete confidence, to design my set and place the miniature, knowing that there will be no likelihood, at a later date, of it being changed.

A good example of this unity between the various departments can be seen in the film "Great Expectations," where the co-operation of the Director

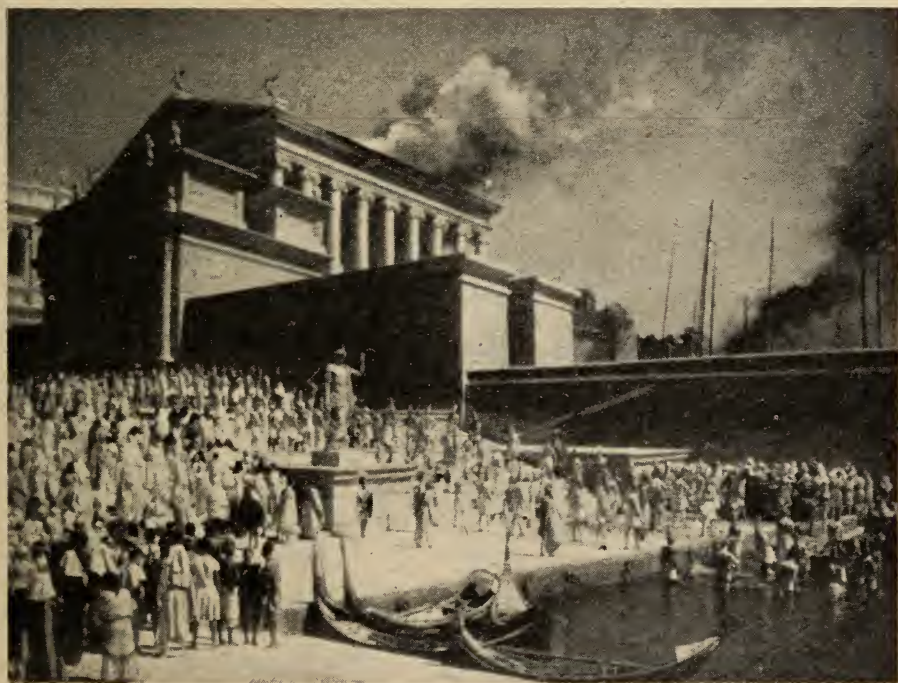


Fig. 4. The Burning Library from "Caesar and Cleopatra." The full scale Flames were at a considerable distance behind the Model Set.



Fig. 5. The Lonely Road scene from "Oliver Twist"—on left as built, on right as photographed. The clouds were formed of Cottonwool, filmed by Back Projection.

and cameraman allowed me to build both miniatures and full-sized sets in forced perspective, thereby creating a very concentrated design.

DISCUSSION

Mr. A. W. WATKINS : In the design of a set, to what extent do you consider the problems of the sound man?

THE AUTHOR : My treatment of set designing involves the use of quite large areas of ceilings that appear low in the picture, and as I think they complete the design of a set and add reality I am insistent on their use. However, this is not done entirely without thought of the sound department, and I discuss carefully with the director beforehand where he is going to play the action, and always try to get him to play it in the foreground, and therefore free of the ceilings.

Mr. W. LASSALLY : Is the set so designed that it can be shot on practically anywhere the director wishes, or is the whole thing planned from the start, as to camera set-up, and built with regard to the positioning of the camera?

THE AUTHOR : I have been fortunate during the last two years in having worked with a director and cameraman who are very knowledgeable about the industry—who know the sort of lens to use, and how to get the best from the cameraman's and art director's point of view. In "Great Expectations," where many of the sets were built in forced perspective, these scenes were carefully discussed with the director and cameraman, so that before anything was built, we all had a clear picture of what the action was going to be, and where it was going to take place. There is no

question of the action being required to take place near a perspective door 2 ft. high.

Mr. IRVING : You made some mention of the nodal head. Do you happen to know if there are many of those available in this country?

Mr. H. HARRIS : We at Denham and Pinewood have four, which we have built ourselves. The camera is suspended in an arc, the pivot of which is in line with the centre of the lens, horizontally and vertically. In the case of Technicolor, the camera uses supplementary lenses which alter the nodal point, and a special nodal head is used.

Mr. L. H. BACON : To what extent are you limited in hanging miniature work by depth of focus?

THE AUTHOR : Hanging miniatures are used for extreme long shots, and you can hold focus roughly between 10 ft. and infinity. When we decide on the scale of the model—generally fixed by the special effects department—the design must be so scaled that the closest point to the camera will not be less than 10 ft. away.

Mr. L. H. BACON : Does that limit the lens aperture?

Mr. H. HARRIS : No, for the most part on hanging miniatures one uses a 35 mm. lens, and on a wide-angle lens it is sharp practically from 5 ft. to infinity, at full opening. Sometimes we have to stop down, but never below $f/4.5$.

EXPOSURE TECHNIQUE FOR REVERSAL MATERIALS

J. F. Dunn, A.M.I.E.E., F.R.P.S.

Read on April 23, 1948, to a joint meeting of the B.K.S. Sub-Standard Film Division with the Kinematograph Section and the Scientific and Technical Group of the Royal Photographic Society.

IN offering this paper it is far from the author's intention to dogmatise in any way, but rather to try to outline some of the exposure problems involved in reversal work, and to suggest some methods of dealing with them.

I. EXPOSURE REQUIREMENTS FOR REVERSAL WORK

The exposure problem for both monochrome and colour reversal film is an entirely different one from that applying to negative materials. A hint of the different approach in the case of reversal work is actually suggested even in negative-positive work by the modern recommendation that the shadows should be placed well down on the negative toe in order to ensure the maximum brilliance in the print. This technique results in the compressing of the shadow tones in the negative, and compensates for the relatively steep portion of the paper characteristic on which this end of the subject range is printed. It results in the lighter subject tones being reproduced more brilliantly, due to the relatively higher degree of contrast given to the upper tone values.¹

A feature of accepted kinema technique is the way in which the brightness levels of certain "key-tones" in the highlights are carefully controlled from sequence to sequence, except where a departure is made intentionally for dramatic effect. The principal "key-tone" is, of course, the human face.

This criterion of constant "key-tones" will be realised to apply to reversal work to a marked degree, both in the still and motion picture fields. If it were not desirable aesthetically it would in any case be required for technical reasons. This applies particularly in colour work, owing to the very restricted brightness range of faithful tone and colour reproduction.

In the case of negative-positive processes this control can, of course, be exercised within limits during the printing operation. No such intermediate control is possible with reversal colour film, and even though compensation for exposure errors is possible in the case of reversal monochrome film, this is nevertheless undesirable if the best results are to be obtained.

"Key-Tone" Control

It will be seen that the simple aim in all reversal work is to find an accurate means of measuring the "key-tone" brightness in the subject, and of "pegging" this at a specific point on the film reproduction characteristic curve.

Consideration of the reasons for accuracy involves an examination of other factors, such as the subject range which it is practicable to reproduce on reversal materials. While in monochrome work high subject brightness ranges of 100 to 1 and more may be photographed, only about the upper 30 to 1 of this can be satisfactorily reproduced. Most colour processes cover satisfactorily an effective range of only about 20 to 1.

It therefore follows that the allowable latitude, with colour film in particular, is extremely small. An error equivalent to plus or minus half a stop will affect the contrast and colour saturation to a noticeable degree, and one stop either way begins to be really serious.

Integrating Meters

It must be obvious that the ordinary photo-electric meter, which merely collects all the light reflected from all objects in front of it within its large acceptance angle, can give no information whatever concerning the limiting or any other specific tone values in the subject. Entirely different readings will be obtained from a photo-electric meter for two subjects which, though they have identical highlight and shadow brightnesses, differ in that one has large areas of highlight brightness, while the other has only a local, but nevertheless important, highlight area. The fact that the "key-tone" may be neither a full highlight nor a shadow tone but, say, a face tone, is not helpful.

II. INCIDENT LIGHT METERS

The "incident light" meter is one answer to the problem, mainly because it effectively disposes of the above inconsistencies. Since the exposure required depends upon the actual brightness levels in the subject, and not upon the average or integrated value as a whole, and since the actual brightness is directly and constantly related to the incident illumination, it follows that the measurement of the incident light can be a highly accurate criterion for reversal film exposure determination.

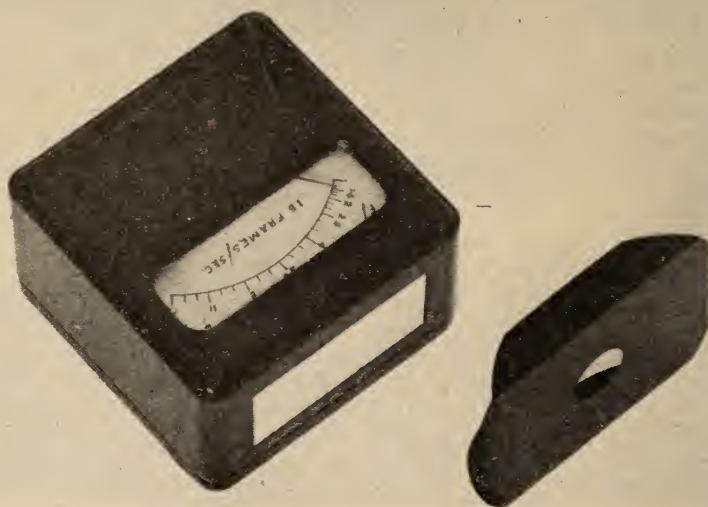


Fig. 1. A Photo-electric (Integrating) Meter converted into an Incident Light Meter. The Calibration is for 27° Film without a Mask. The Mask shown converts it to 21°.

The well-known example of commercially obtainable incident light meters in this country is the Avo-Smethurst Highlight Meter, which has a flat and fairly unrestricted opal window in front of the photo-electric cell. In the U.S.A., the Norwood Incident Light Meter employs a hemispherical opalescent window instead of the usual flat opal window, so allowing it to collect a proportion of the back lighting. Several of the integrating meters available in the U.S.A. are now being made so that they can be converted into incident light meters at will, notably the De Jur dual-purpose meter, the American G.E. meter, and the Weston meter.

It is a comparatively simple matter to convert an existing integrating photo-electric exposure meter into an incident light meter. Certain essential precautions must be taken, dealt with in detail in Appendix I. A converted meter is shown in Fig. 1.

Methods of Application

There are two general methods of applying the incident light meter. One, as usually recommended in the past, is to point the meter directly at the major source of illumination, *i.e.*, the sun in daylight, or the principal lamp in artificial light. The other method is to point the meter directly at the camera. It can be argued theoretically that the latter is the more logical if, for example, face tones as "seen" and recorded by the camera are to be "pegged" at a specific point on the reproduction characteristic. Such a technique will result in those diffuse "key-tones" which are normal to the camera direction being reproduced at a constant level irrespective of the direction of the lighting.

The solution is not as simple as this, however. Apart from the effect of the altitude of the light source, these two methods obviously coincide in the case of a flatly lighted subject, since both the major light sources and the camera are then in the same general direction as viewed from the subject. It is in the case of side and, particularly, back lighted close-up or high contrast subjects where difficulty usually arises.

For a back lighted subject, pointing the meter at the major light source gives a result which is too dark, because it ignores the large shadowed areas facing the camera and which, consequently, are under-exposed. Pointing the meter at the camera results in the reverse effect, the shadowed "key-tones" then being "lifted" to the same level as they would be in a front lighted case.

It is therefore suggested that neither of these methods is correct, and that one giving an intermediate exposure is required, which at the same time allows for varying light source altitude. Furthermore, the subjectively correct balance between screened highlight and shadow tone levels appears to be approximately related to their respective areas, and this should also be catered for.

"Duplex" Method

A method which largely avoids the above difficulties has been called the "duplex" method, because it involves taking, in all but the basic front lighted case, two readings, one pointing the meter directly towards the camera and the other towards the direction of the major source of illumination, but still directing the meter horizontally, the exposure to be given then being somewhere between the two indicated values.

Thus if the camera direction reading is $f/2.8$ and the source direction reading is $f/11$, the aperture used would be $f/5.6$. This is actually an extreme case.

In the exceptional cases of high key or low key subjects, where there is a risk of the objective reproduction being respectively at too high or too low a level to be acceptable subjectively, or because of technical limitations, the usual advice of a half to one stop additional correction can be superimposed on to the "standard" exposure given by the above method. The need for this control is in the main confined to high key effects on the one hand and to very dark objects on the other.

The procedure described does not, of course, in any way modify the usual advice to avoid undue contrast in the subject. The limit met with in open daylight results in a ratio between the directional readings of about four stops, resulting in an exposure correction of two stops from the directional readings. Any greater degree of lighting contrast than this should, in general, be rejected, particularly in colour work.

Using the meter in all cases to read the horizontal component of the incident light gives a marked degree of correction for varying altitudes of the light source.

Calibration of Incident Light Meters

Data are given in Appendix II to enable any incident light meter to be checked, or initially calibrated if converted as described in Appendix I. The calibration equation given takes the same form as that given for photo-electric exposure meters in B.S.1383, 1947, and a list (Table I) of reversal film exposure indices for daylight and photoflood covering most of the well-known monochrome and colour materials, both still and motion picture, is included.

While the incident light method gives excellent results in the case of straightforward work, it nevertheless has certain limitations. Some of these are summarised below :—

- (a) Incident light meters must be used from the subject position (except where the lighting at the camera is the same as at the subject, this usually being the case in daylight owing to the remoteness of the source).
- (b) They ignore the exposure modifying effect of haze between the subject and the camera.
- (c) They cannot be used for "self-luminous" subjects.
- (d) They are limited to exposure level estimation and are neither convenient nor accurate for the measurement of subject contrast nor for the *camera position* control of lighting balance. (They can, of course, be used *at the subject* for this latter purpose).

III. EXPOSURE PHOTOMETERS

The principal application of the exposure photometer is in the making of negatives for subsequent printing. It appears, however, to have a number of applications to reversal work, and its principal attribute of measuring the *brightness* of a *small area* in the subject *from the camera position* allows it successfully to avoid the above-mentioned limitations of the incident light meter.

It has its own limitations for this work, however, and it would seem that both the "incident light" and the "keytone brightness" methods have their own spheres in the solution of the reversal film exposure problem. Since, however, it can be used also as an incident light meter by simply clipping on to it an "incident light attachment," consisting of an opal diffusing disc, the exposure photometer can be said to be an "all-purpose" instrument.

Requirements for Universal Exposure Meter

The following are therefore suggested as being the principal requirements of a universal exposure meter for reversal work :—

- (1) It should be capable of application to both the incident light and the keytone brightness methods.
- (2) While for the incident light method it must be used either at or in the same illumination as the subject, for the keytone method it should be used from the camera position. (a) for convenience of operation and (b) so that it will measure the keytones as "seen" by the camera (*i.e.*, allowing for "atmosphere" between camera and subject).
- (3) In order to measure the keytone brightness, it must have a very small effective acceptance angle (preferably under 1°) and adequate range.
- (4) Its readings should be consistently accurate to at most one-third of a stop.
- (5) If of the optical type its readings should be independent of human eyesight variations.
- (6) It should be portable, and at least as robust as an ordinary photo-electric meter.

As already indicated, a correctly designed exposure photometer can meet all these requirements. An instrument of this type, developed by Mr. G. S. Plant and the writer, has been put on the market as the "S.E.I. Exposure Photometer" (Fig. 2)^{2,3}. In reversal work its applications to the incident

light method are, of course, the same as described above under "Incident Light Meters." Its keytone applications will now be considered.

Keytone Technique

Since the S.E.I. Photometer measures the brightness of an area in the subject which is included within a measuring acceptance angle of only half a degree, it can obviously be used from the camera position to "peg" any subject keytone at any desired level on the reproduction characteristic. Furthermore it is, in practice, a very simple instrument to use despite its apparently complicated construction.

After applying a reversal film exposure index setting which has been corrected in line with the reflection co-efficient of the keytone selected (this is explained later), and after making a preliminary check that the internal comparison surface brightness is set at the standard brightness level, the photometer is directed towards the keytone in the subject which is required to be reproduced at a predetermined relative brightness level. After pressing the switch button and rotating the base of the instrument until the spot brightness exactly matches the image area surrounding it, the exposure required to place the measured keytone at the correct relative level in the positive reproduction is read off directly.

The calibration is such that the only preliminary information needed in addition to the basic reversal film exposure index (as given in Appendix II, Table I) is the approximate reflection co-efficient of the surface being measured. From this is derived an exposure index correcting factor; or this can, for consistent surfaces, be obtained directly from a table (see Appendix III, Table II). This *keytone correction* is then added to the basic index to give the *keytone exposure index* necessary to peg the tone measured at its correct reproduction level.

Practical Application

For example, the daylight reversal film exposure index for Kodachrome is given (see Appendix II, Table I) as 21° . The approximate reflection co-efficient of an average face tone is 30% and the corresponding *keytone correction* (see Appendix III, Table II) is 5° . This gives a *keytone exposure index* of 26° , which is accordingly the value on the photometer film speed scale against which the white film speed index is to be set. The above operating procedure is then followed, and the part of the face tone measured will automatically be placed at the correct relative brightness level in the resulting transparency.

For remote or self-luminous subjects, an estimate of the part of the subject

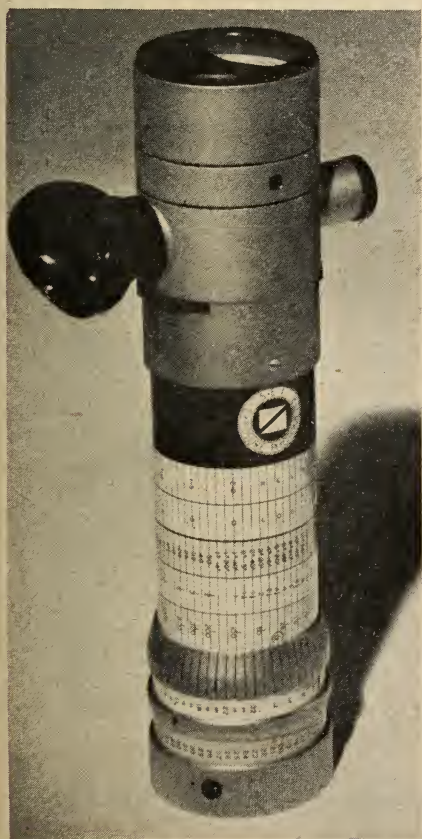


Fig. 2. The S.E.I. Exposure Photometer, which can be applied to the Keytone Method of Exposure Estimation for Reversal Film. Its effective Acceptance Angle is only half a degree. It can also be used as an Incident Light Meter if required.

which is to be reproduced as objective white (or any other required tone level) must be made, the chosen area being then matched with the photometer. Here again it is necessary to adjust the exposure index setting in line with the estimated reflection coefficient of the surface matched.

Any additional deliberate raising or lowering of the subject tone scale can obviously be superimposed by a modification of the photometer setting in order to give any required subjective effect, a rise in the exposure index number resulting in less exposure and *vice versa*.

Control of Lighting Balance

The ability of the photometer to measure the brightness contrast between different parts of the subject allows the lighting intensity and balance to be checked initially *from the camera position* for still work, and continuously, if desired, in motion picture work. The S.E.I. Photometer also has "brightness" scales reading directly in foot-lamberts or log. foot-lamberts as required, and these allow the instrument to be used for checking relative tone reproduction on the screen, in the same brightness terms as can have been measured with the same instrument on the original set. It can, of course, also be used to check the basic screen brightness as related to B.S. 1404 : 1947 "Screen Brightness for the Projection of 35mm. Film." The limits specified are 8 to 16 foot-lamberts, but some relaxation for sub-standard work appears to be allowable; it is considered that the level should not fall below 4.5 foot-lamberts, however, if satisfactory reproduction quality is to be maintained. These values apply when measured normal to the screen with the projector running with an open gate.

The adaptation of the photometer to function as an accurate diffuse reading micro-densitometer also enables positive (or negative) characteristic curves to be plotted if this method of approach to the checking of reproduction quality is preferred to that of making brightness measurements of the projected image.

Details of the calibration data for this type of photometer are given in Appendix III for those interested in such technical matters.

Photometer "Incident Light" Technique

The requirement was specified earlier that the photometer should also be capable of being used as an incident light meter. All that is necessary to effect a quick conversion is to clip on to the front of the telescope a piece of thin pot opal glass or white celluloid, having a transmission factor adjusted to give the necessary calibration shift so that direct exposure readings can be obtained.

The "incident light" disc can conveniently be mounted in a clip-on ring like a filter, the front rim being flat and very thin so that all the light from a complete hemisphere falls on the front surface of the disc.

The application is the same as that covered under "Incident Light Meters," and identical results will be obtained. This application of the photometer is mentioned because it completes the scope of the instrument. It is not suggested that a converted photometer has any advantage over a photo-electric incident light meter, except the very obvious one of combining in one instrument the advantages of both.

Conclusion

In conclusion, the writer would like to acknowledge his grateful appreciation to his colleagues, Messrs. G. S. Plant and L. C. Walshe, for their constructive criticism and practical assistance during the preparation of this paper.

The paper was illustrated by a number of 16mm. Kodachrome films, illustrating the "duplex" and key-tone systems of exposure assessment.

APPENDIX I

CONVERSION OF INTEGRATING METERS FOR USE IN INCIDENT LIGHT.

Any photo-electric integrating meter can readily be converted into an incident light meter by arranging a piece of pot opal glass in front of the photo-cell window so positioned that light from the complete hemisphere in front of it is collected.

The absence of any hooding or other acceptance angle restricting device *in front* of the opal window is an essential feature of a correctly designed incident light meter. It is not, however, normally necessary to remove any existing restricting device provided that it is *behind* the opal window. A *flat* mask can, however, be used in front of the opal glass, and this may be found useful for calibration adjustment.

APPENDIX II

CALIBRATION OF INCIDENT LIGHT METERS.

The calibration equation used for the writer's incident light meter and exposure photo-meter was as follows:—

$$\frac{I \text{ (or } K^*) \times T \times 10^{R/10}}{f^2} = 400 \dots\dots\dots A$$

where I = incident light (foot-candles) normal to the opal screen of the incident light meter,

(or K^* = brightness (foot-lamberts) of the calibrating screen for the photometer described.)

T = exposure time setting (seconds).

f = indicated lens aperture.

R = reversal film logarithmic exposure index as given in Table I below.

TABLE I.

SUGGESTED BASIC REVERSAL EXPOSURE INDICES FOR "INCIDENT LIGHT" METERS (OR PHOTOMETERS*) CALIBRATED TO EQUATION "A" FOR THE METHODS DESCRIBED.

Reversal Film.	Basic Exposure Index—Degrees	
	Daylight	Photoflood
<i>Monochrome</i>		
Gevaert 16 and 9.5mm. Ultra Pan.	32	31
„ 16, 9.5 and 8mm. Super Pan.	26	25
„ 16, 9.5 and 8mm. Micro Pan.... ...	23	22
Kodak 16mm. Super XX	32	31
„ 16 and 8mm. Super X	28	27
„ 16 and 8mm. Pan	22	21
Pathé 9.5mm. P.S.P.F.	28	26
<i>Colour</i>		
AnSCO Color Film (Daylight)	21	—
„ „ „ (Photoflood)	21†	21
Dufaycolor (types D2, D4 and D5)	18†	—
Ilford type D	22	—
Kodachrome (Daylight)	21	—
„ (Type A)	21†	22
Kodak Ektachrome (Daylight)	21	—
„ „ (Type B)	19†	21

*See Appendix III.

†Including recommended filter.

The values given in this table are suggested as a guide. The precise basic exposure index will depend, to the extent of one or two degrees, on the equipment used (*e.g.*, variations in lens and shutter efficiencies between different cameras) and on the freshness or otherwise of the film stock. It is generally advisable to err on the high side, since the effect of under-exposure is better than over-exposure, particularly with colour film.

It will be seen that equation A is given in the same form as Equation II in B.S. 1383 : 1947, "Photo-Electric Exposure Meters." Meters can be calibrated either against a standard lamp, or a reliable make of commercial illumination meter. In the former case, the usual photometric precautions as described in Appendix A.3 of B.S. 1383 "Photo-Electric Exposure Meters" must be taken.

In either case the thickness of the opal screen should be adjusted (using under it a mask or neutral filter if necessary) until on the top range the needle is registering against the top scale mark when the opal screen is illuminated at 6,400 foot-candles, this being about the maximum horizontally disposed illumination encountered in daylight. This point can conveniently be labelled 6.4 (thousands of foot-candles). The rest of the scale should be checked for calibration at each halving of the incident light value, *e.g.*, $f/16$, 11, 8, 5.6, etc. Two intermediate marks will then give the intermediate stop numbers, so that each division represents a change of one-third of a stop.

The scale can either be marked in foot-candles as suggested and a table used to show the equivalent stops for varying exposure index settings, or it can be marked directly in stop numbers for some particular exposure index, in which case a conversion table will be needed only when a film of a different speed is used.

Another method is to calibrate the meter directly in stop numbers for the fastest speed likely to be used, and to use *flat* removable masks over the opal screen adjusted to give the necessary calibration shift for other film speeds. With this arrangement, a single shunt range on the meter microammeter may be found to be adequate for the stop or exposure range required. To attain this convenience in some cases it may be necessary to increase the series resistance in order to close up the higher scale divisions; this must not be overdone, however, or positive photo-cell drift may be introduced at the higher illumination levels.

APPENDIX III CALIBRATION OF EXPOSURE PHOTOMETERS.

TABLE II

EXPOSURE PHOTOMETER KEYTONE EXPOSURE INDEX CORRECTIONS.

(Recommended for use when the keytone surface is facing *horizontally in the direction of the major light source*.)

Reflectance of Keytone matched, %.	Typical keytones	Keytone correction to basic exposure index.
100	Magnesium carbonate block ("Standard White")*. Fresh snow (brightest area). Sunset cloud fringes (not too near to sun).†	Basic exposure index. (Table 1).
80	White blotting paper. Matt white card. Clean white paint.	+1°
65	Slightly weathered white paint.	+2°
50	Old weathered white paint.	+3°
40	—	+4°
30	Normal face tone (diffuse highlight).	+5°
25	—	+6°
20	Bronzed face tone (diffuse highlight).	+7°

* Obtainable commercially in block form 2 in. \times 1½ in. \times ⅝ in. in cardboard box labelled "Standard White," the surface of this material is an internationally accepted standard of diffuse white (average reflectance over visible spectrum=98.3%). It forms a nominal 100% keytone test surface which is continuously renewable by lightly scraping.

† For sunsets give double the indicated exposure (colour sensitivity correction).

Keytone Method. An exposure photometer can be arranged so that when the reversal film exposure indices given in Appendix II, Table I are used, its calibration equation is numerically the same as Equation A (also Appendix II). This is a very convenient and logical arrangement as will be seen below.

The indicated exposure of a photometer which has been calibrated to this equation will be the same as that indicated by an incident light meter *only when the photometer spot is matched on a hypothetical diffuse white surface which reflects 100% of the incident light.*

Since it is in any case essential for a photometer to have a "sliding" calibration in order to allow it to be applied to a variety of tone levels in the subject, it is considered that the most logical basis for this "sliding" scale should be the actual reflection coefficient of the surface to be matched. The simple addition to the basic exposure index (Appendix II, Table I) of a logarithmic "keytone correction" obtained from the reflection coefficient, of 1° for every 0.1 drop in log. reflection coefficient below the 100% datum level of 2.0 is then all that is necessary.

An example of the application of this technique when using a photometer calibrated on the basis given above is as follows:—

Reversal material	...	...	...	...	Kodachrome (daylight)
Basic exp. index (from Table I)	...	...	...	...	21°
Keytone matched	...	...	...	...	Face in front lighting.
Keytone correction (from Table II)	...	...	...	...	$+5^\circ$
Keytone exposure index	...	...	...	...	26°

This method of calibration has been used for the S.E.I. Exposure Photometer, and applies when the white "film speed" setting index is used. This index gives the photometer a calibration shift along the log. E axis of $+2.0$ (i.e., relative $E \times 100$) from the shadow method calibration level (black index) as used for negative work. The "black" calibration level is set to a "safety factor" of 2° above the B.S. and A.S.A. "fractional gradient" film speed point for the average case.⁴

REFERENCES

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DISCUSSION

Mr. CHADWICK: With regard to ascertaining the reflection coefficient for the keytone method, is this just a matter of practice?

THE AUTHOR: The approximate reflection coefficient can usually be estimated to within 1° (a third of a stop) after a little practice.

Mr. R. H. CRICKS: What about the angle of the keytone surface with respect to the direction of the light source?

THE AUTHOR: The keytone surface matched should be one facing approximately horizontally, but in the direction of, the major light source. An artificial keytone often has to be used where the highest accuracy is required.

A MEMBER: With the duplex method do you take any account of a specular reflection from the subject towards the camera?

THE AUTHOR: Such specular reflections usually take the form of small "catch lights" in the subject, and are ignored.

Mr. PERCY HARRIS: I have had the opportunity of using the S.E.I. meter for about a month and it has a very wide value, not only for kinematograph work,

but with still colour and black-and-white. It is extremely simple to use; it is extraordinarily easy, in a minute or two, to measure the range. One can then automatically place the exposure about where it should be. I have found the shadow method very effective for negative work. For highlight work there is only one slight difficulty; if you are using the highlight method on this meter you have to use the upper range, and matching is not quite so easy.

Mr. S. W. BOWLER: The question of the use of the shadow method may be related to the effective flare light from the camera lens.

THE AUTHOR: The shadow method, while being quite satisfactory for negative work, is not recommended for reversal work. Part of the reason for this is the question of flare in the camera and its relationship to the smaller amount of flare in the photometer. For negative work a small and controlled amount of flare in the photometer actually compensates for the effect of the slight increase in film speed which results from the small fogging effect of flare in the camera.

ARC LAMP REFLECTORS FOR MOTION PICTURE PROJECTORS

A. Brown, A.R.P.S., M.B.K.S.*

Summary of paper read to the B.K.S. Newcastle-on-Tyne Section on November 4, 1947

THE demand for increased screen illumination coupled with improved electrical efficiency led to the introduction of the reflector arc lamp. Earlier models employed spherical mirrors, originally 5½ in. in diameter. Such mirrors were, however, subject to spherical aberration, which causes the mirror to focus the rays at different points along the principal axis. This results in an unclearly defined spot at the gate, and an uneven field of light upon the screen.

They were therefore replaced by a parabolic mirror used in conjunction with a condenser of similar diameter, and later an ellipsoidal mirror.

Fig. 1 illustrates the principle of the ellipsoidal mirror, the crater being located at the first focal point, and the mirror reflecting a conical beam of light to the gate of the projector.

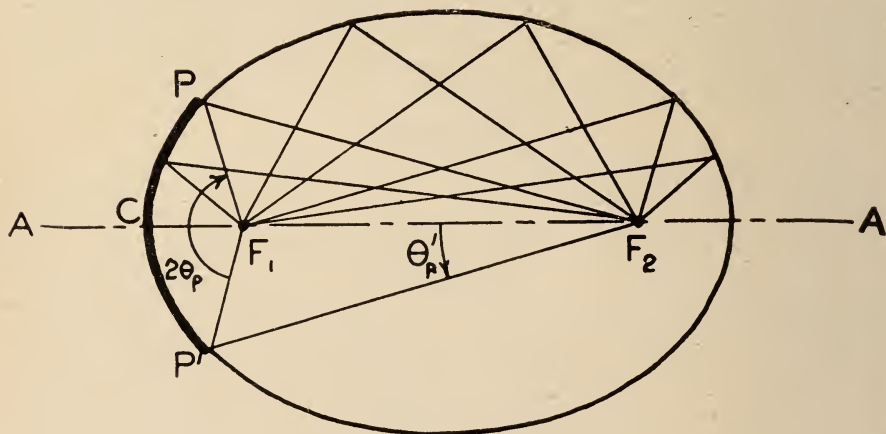


Fig. 1. Principle of Ellipsoidal Mirror.

The positioning of ellipsoidal mirrors is critical; the distance from the centre of the back of the mirror to the conjugate or secondary focus must be rather greater than the distance to the gate.

Properties of Mirror

Attention has previously been drawn to the necessity of matching the f value of the mirror with that of the projection lens. Three fundamental constants governing the action of an ellipsoidal mirror are:—

1. The angle of collection— 2θ .
2. Speed or f number— $2F_1 \sin \theta$.
3. Magnification factor— $\frac{F_2}{F_1}$

It will be seen that to increase the angle of collection from the positive crater the mirror must be placed close to the crater, with the corresponding

danger of mirror damage through heat and carbon pitting (especially where the projection angle is steep) : alternatively the diameter must be increased.

As an example, the Gaumont Kalee "Light-master" arc lamp, which has a mirror of 16in. diameter, with focal lengths of 6in. and 36in., has a collecting angle of approx. 140°. The comparatively long primary focal length of 6in. effects a considerable reduction in carbon splash, and reduces the liability to damage through heat.

Choice of Glass

Early arc lamps employed ordinary window and plate glass for kinema reflectors, but with the increased light and consequent heat, a glass of greater silica content was necessary. With their higher resistance to heat, borosilicate glass, Chances' heat-resisting glass, and similar types were brought into use. Such glass is reputed to soften at about 700° C., and it is claimed that it can be quenched in cold water from 240° C. without breaking.

"Pyrex" glass, which is now being used in modern arc lamps, is a form of laboratory glass with an 80% silica content, and a softening point around 800° C. Unfortunately, due to its peculiar character and the method of manufacture, it is difficult to handle in use. It cannot be produced in a very fine grade and even with the maximum degree of finish, it does not present to the user that *sheer* appearance found in a properly worked mirror of plate glass. Pyrex, compared with a plate glass, has a slight discoloration and a moulded or veined appearance. It is more subject to bubbles and pot than most glasses, but despite its appearance its reflectivity is in no way impaired. Its appearance, therefore, is outweighed by its thermal efficiency.

Manufacture of Mirrors

The first process in the manufacture of mirrors is to bend or form the glass to the shape required. This is done in heavy metal moulds; the flat glass circle is laid over these moulds, which are then deposited into gas-heated furnaces which are temperature controlled. While in the furnace the mould, upon which is resting the glass disc, is slowly revolved to ensure even distribution of heat. As the glass reaches its softening point, the disc settles into the mould, taking up its predetermined shape.

When the bending of the glass is completed, it is removed from the furnace to a special annealing chamber, where cooling takes place very slowly. The glass is afterwards ground on a flexible grinding head, which removes any skin or other obstruction formed during the surface treatment. It is then transferred to high-speed polishing machines, where thick spring-loaded felt pads, covered with a rouge solution, are revolved in such a manner as to leave no part of the surface unpolished. This is important in securing a high degree of reflectivity and optical accuracy.

After an examination the glass is roughly cut to diameter, and the edges ground smoothly to the required size. Any cut-outs or holes specified in the finished article are then cut and ground out.

Silvering Mirrors

To ensure absolute cleanliness, the glass to be silvered is washed by chemical processes. Silver nitrate is the basic medium used in the process of silvering, and a heavy coating is chemically deposited on the convex surface of the glass. It is followed by an electro-deposited coat of copper applied in-vat. After careful examination, the mirrors are then given a coat of heat-resisting and anti-oxidising paint.

In certain mirrors a further metallic backing is applied in sheet form. Spun copper, aluminium or thin sheet lead is used, and the backing chosen

tends to distribute the heat evenly over the back of the reflector. The backing also prevents the mirror falling to pieces should it be broken.

Testing Mirrors

The finished mirrors are subjected to interesting tests for accuracy. Ellipsoidal mirrors are set up in a frame, and a small source of light is placed at the primary focus. The light is projected on to a ground glass screen situated at the secondary focus, in the form of a small spot, upon which limits are placed according to the size and shape of the image.

Metal Mirrors

Apart from glass mirrors, there are various types of metal mirrors obtainable, such as chromium plate on steel, and rhodium plate on copper. Metal mirrors withstand heat better than glass, and are not liable to break from knocking or sudden cold draughts, nor do they suffer from carbon splash. Their disadvantages are that they transmit more heat to the gate because of the surface plating, and are more liable to abrasion from cleaning, and, if fitted tightly into the mirror gimbal, to distortion. Distortion also occurs if they are dropped, although they may not break.

Developments are said to be proceeding with aluminium reflectors in this country and abroad. While they will have better lasting qualities, they will undoubtedly introduce more heat to the gate. The surfaces of the reflectors can be anodised, a process which gives the surface a greatly increased hardness.

BOOK REVIEWS

THE KODAK MUSEUM, Kodak, Ltd., Wealdstone, Middlesex.

In planning this book, Kodak set out to compile a museum catalogue; but in fact they have produced what might almost be called a basic material of philosophy—because nobody with the least imagination can glance through such a work without being reminded impressively of the enormous debt which each generation owes to the pioneer work of its predecessors.

The 90-page book is, as the name indicates, a catalogue of the photographic apparatus accumulated in the company's museum. The 26 sections, lettered A to Z, give not only a list of the most important of the exhibits there, but brief summaries of these inventions and processes that constitute the milestones of the art, beginning with a section on "pre-photography silhouettes."

Illustrations, some in colour, enhance the work, and contribute to an attractive make-up. The book is, in fact, a production of which Kodak can well be proud—a book which shows that, since 1927, when the first exhibits were assembled, Kodak have built up a museum of international interest.

The book is not produced for sale, but copies can be obtained (10s. net) from Kodak, Ltd., Sales Service Library, Kingsway.

J. C. WARBIS.

FRIESE-GREENE: CLOSE-UP OF AN INVENTOR. By Ray Allister. Marsland Publications, 192 pp., 12s. 6d.

Inventors are notoriously eccentric, ever optimistic, and unbusinesslike, and usually fail to profit from their inventions. Here is the tragedy of a man who sacrificed his business, his fortune, his wife and family, to the urge to invent.

Without question Friese-Greene anticipated practically all developments in cinematographic technique, in colour, in stereoscopy. But was he the first and true inventor of cinematography? The author of this book admits of no doubts. Of 78 patents listed, the majority relate to some aspect of cinematography, commencing with his famous patent of 1889. The surprising statement is made, however, that this patent was never tested in the American courts, as has been stated, but was merely established by default.

The work makes no pretence to being a technical dissertation; it is a sympathetic account of Friese-Greene the man—an account which, so far as the present reviewer is aware, is scrupulously accurate, although it could have been more complete had the author consulted more of the technicians who worked with Friese-Greene. It is a book that should be read by all of us who owe our livelihoods to Friese-Greene's inventions.

R. H. CRICKS.

PROJECTION PROBLEMS

At the meeting of the B.K.S. Theatre Division held on April 18th, 1948, problems relating to projection were answered by members of the Committee.

THE POSITIONING OF SPEAKERS

W. F. Garling, M.B.K.S.*

In the light of modern development is it still essential to have speakers positioned behind the screen? What experimental work has been carried out to determine the disadvantages of having speakers positioned at the sides of the screen or pointing at the screen?

IT is not absolutely necessary to locate the loudspeaker system at the rear of the screen. In the case of kinemas having rear projection the loudspeakers are usually located at the sides of the screen or at the top.

The main disadvantages of having speakers positioned at the sides of the screen result from :—

- (1) Defective acoustic conditions in the auditorium.
- (2) Difficulties due to the necessity of structural alterations.
- (3) Cost.

1. (a) With loudspeakers located at either side of the screen it is difficult to obtain good "illusion" in the front portion of the auditorium, particularly where the screen is located close to the front row of seats.

(b) In a great many instances acoustic difficulties are created when there are several separate sources of sound. These difficulties may be due to interference caused by crossing the centre axes of the speakers, or to excessive reflections caused by directing the speakers (horns) at the side walls of the auditorium, or a combination of both.

2. In many instances in existing kinemas it is impossible to install modern loudspeaker systems at either side of the screen owing to the necessity for extensive structural alterations. This is caused either by a lack of space or by the fact that the sides of the proscenium arch may interfere with the directing of the sound when each speaker system is to be directed towards the opposite side of the auditorium.

3. Equipment and installation costs are increased with two separate speaker systems. It is appreciated that this extra cost would, to a certain degree, be offset by not having to replace the sound screen at intervals, but it is probable that the total cost over a period of years would be greater.

Concerning the suggestion of directing the speakers towards the screen and covering the seating area with sound reflected from the screen, this is not desirable, mainly due to the fact that sound quality is best when the main portion of the sound received by the auditor is direct from the source.

MR. R. PULMAN : It seems to me that if a theatre were specially designed to have the speakers placed on the sides of the screen, Mr. Garling would not offer any strong objection, as the sound always suffers from the clogging of the screen perforations.

MR. GARLING : In my view, if a theatre were designed in a manner that allowed the location of the loudspeakers other than behind the screen, it would probably be desirable to place them above the screen rather than at the sides.

MR. H. CRICKS : As I have before recalled, in my first talkie installation, we had an old theatre, and put the speakers in the wings, directed towards the screen. More recently, in connection with an

auditorium for which I was consultant, we considered the same proposal, but found it was not possible to place the speakers sufficiently far forward to provide correct angles of reflection, owing to the lack of depth on the stage.

MR. W. V. DEWAN : If you were considering a theatre specially constructed for sound, would it not be advantageous to have a large number of non-directional speakers in the auditorium?

MR. GARLING : In ordinary stage productions, the voices of the actors are directional; I cannot agree with the proposal so far as speech reproduction is concerned. For certain sound effects, and possibly music, it might be alright.

FLUCTUATIONS IN SUPPLY VOLTAGE

W. V. DeWan, M.B.K.S.*

What are the difficulties introduced by variations in the supply voltage and frequency?

VARIATIONS of supply voltage and frequency do not play a large part in the kinema. We have suffered during the power cuts from variations, but they have not affected us materially, beyond their effect on clocks. I experienced a difficulty once during an organ interlude, when there was insufficient speed on the motor to run the pneumatic system at full speed, and there was consequently low volume.

Mr. LAVELLY: Surely if the mains voltage drops, the screen illumination drops?

Dr. F. S. HAWKINS: It is a fact that a 1% change in current through an arc will produce about 4% change in light. Therefore, you must keep an eye on the ammeter.

Mr. A. KERRIDGE: The arc itself is flexible. The average projectionist can accommodate small changes in supply volts. Is the change in light due to current, regardless of the wattage in the arc?

Dr. F. S. HAWKINS: The thing that actually matters is the power dissipated in the positive crater. You can control the current passing through the positive, you should be able to control the voltage drop across it—possibly by putting the carbons

in an unorthodox position.

Mr. W. F. GARLING: The previous speakers have been mainly interested in the picture. In regard to the sound, it is well known that with modern amplifiers operated from an A.C. supply, a change in the supply voltage produces a change in the output voltage. Not only does the amplification factor change, but both the photo-cell and exciter lamp voltages are altered. In the event the supply voltage is reduced, the changes mentioned are additive as regards reduction of the sound volume.

To avoid variations in sound volume due to voltage supply changes, every first-class kinema should have a voltage stabiliser for the amplifier supply.

DIAMETER OF ARC MIRRORS

S. B. Swingler, M.B.K.S.†

What factors determine the diameter of the arc mirror in relation to light output?

ONE fundamental factor is, of course, the collecting angle. Assuming a carbon trim for 50 amps, the relation between the major and minor foci determines the magnification of the positive crater—about 1:7. But obviously economic factors enter into the matter. The cost of a mirror varies approximately as its area. To increase the collecting angle above 165° to 170° gives little increase in light.

The graph of reflectivity plotted against angle shows that the peak of reflectivity occurs well below 90°.

It seems possible that in future we may see a very slow-burning carbon, which may increase the efficiency of a lantern by enabling the crater to be closer to the gate (due to the reduced length of positive carbon then necessary).

Mr. A. KERRIDGE: How would you improve the efficiency of the arc by shortening the distance between the mirror and the aperture?

Dr. F. S. HAWKINS: The diameter of the 8mm. carbon is approximately one-seventh the diagonal width of the gate aperture, so that you have to magnify your crater image sufficiently to cover the

gate. If you use a large diameter carbon, your ratio becomes smaller. Within quite broad limits, you can keep the optical factor of the system the same, regardless of the size of mirror.

Mr. R. PULMAN: One must remember that a 10½in. mirror enables one to build a smaller lamphouse around it, and therefore have a cheaper lamp.

*G.-B. Picture Corporation

†Circuit Management Association

AUDITORIUM LIGHTING

L. Knopp, Ph.D., M.Sc., F.I.E.S., F.B.K.S.*

Is it likely that a degree of auditorium lighting, sufficient to make unnecessary the use of torches, will be realised in this country?

IN dealing with this question, there are several factors to be considered. First is the human eye, which is a very complex mechanism; it is capable of visual perception at illuminations from 1/500th foot-candle up to 1,500 foot-candles or more. Throughout this range the visual acuity is not constant, nor can the eye immediately accommodate itself to widely different light intensities. Therefore, regard must be paid to the period of time necessary for the eye to become adapted to the low intensity of illumination in the auditorium.

With persons coming from bright sunlight into an auditorium, I would say that it is not possible to have the necessary high degree of illumination in the auditorium to enable them immediately to see the way to their seats. If, however, we provide for a delay before reaching the auditorium, or if we consider persons entering a kinema at night time, the problem is comparatively simple. The period of time required for dark adaptation could be provided by a foyer or an entrance corridor of sufficient length and with a suitable diminution of brightness of illumination, so that the eye could accommodate itself to the level of the illumination.

Some time ago, measurements were made in several London kinemas and it was found that the degree of illumination with safety and primary lighting in operation, without the picture on the screen, averaged .01 foot-candles. Tests were carried out under the auspices of the Illuminating Engineering Society to find the degree of illumination necessary for a reasonably dark-adapted person to see his way to his seat without the use of a torch. It was found that, to do this, the illumination at the point of his entrance into the auditorium should be not less than 0.8 foot-candles white light uniformly distributed. If we proposed to provide coloured lighting, lamps of higher wattage would be required; a flame-coloured lamp would have to be twice the wattage, green five times, red sixteen times and blue no less than 39 times.

This brings us to the next consideration. What is the maximum illumination one could have in an auditorium without impairing the quality of the projected picture? Many tests have been carried out and it has been found that if the average screen illumination is approximately 100 times that of the average level of auditorium illumination, then the effectiveness of the picture is not impaired provided, of course, that the screen is protected from stray light. The precise proportion is given by the formula:—

$$\frac{E_s - 2.5}{100} = E_a$$

It should be mentioned that this level of .08 foot-candles white light found to be necessary is dependent upon the decorations of the auditorium being of a reasonably light colour and that there is a suitable contrast in the colour of the seating and carpeting. This level of illumination was also determined when the screen illumination was not less than 11 foot-candles with the shutter running, but without film.

I am afraid that it will be a very long time before kinema auditoria are illuminated to this high level.

Mr. R. H. CRICKS: Mr. Knopp might have stressed more the influence of colour and contrast. It has often occurred to me that patrons could see their way more

clearly if chairs were fitted with white plastic arm-rests. They would not be seen by patrons when seated.

Mr. R. PULMAN: They would often be

an annoyance to patrons in the circle, who can see the arm-rests in the stalls.

Mr. L. KNOPP : I think the employment of an usherette with a hand torch properly handled, more satisfactorily controls incoming patrons. If the torch is properly used the patron feels that he is receiving the personal service of the usherette. Mr. Cricks has suggested white arm-rests ; from tests carried out some time ago, we found that the best contrast at low illumination was a rather light red, a pea-green, and grey, irrespective of the colour of the illuminant.

Mr. S. B. SWINGLER : Mr. Knopp and others may remember the activity some years ago in illuminated screen surrounds. It was found to be a physiological fact, that illumination outside the screen area was not unattractive, nor inclined to take away the effect of the picture.

Mr. KNOPP : Great contrasts in light values are annoying to the human eye. A brightly illuminated screen with a dark surround causes eye fatigue. An illuminated screen is restful to the eye, and enhances the apparent brilliancy of the picture.

FLASH-LAMPS IN PROJECTION

J. A. Walters, M.B.K.S.*

In the event of the development of the extremely high intensity short duration flash discharge lamp, is any consideration being given to its application to a non-intermittent film projector?

SOME consideration is very definitely being given to the use of the flash tube for projection, but rather more in terms of a conventional intermittent projector than with non-intermittent continuously running film. There are quite a number of technical difficulties.

In the first place, the characteristic of the tube is a flash of very high intensity and short duration, and the question arises whether there will be sufficient light available to illuminate a kinema screen. The modern 60-ampère high-intensity arc lamp has an output of about 115,000 lumens. The picture frame is illuminated for about 1/48th second, which gives an effective light of some 2,400 lumen-seconds per frame. To run a continuously moving film and to get a sharp picture on the screen effectively to arrest the motion of the film would need a flash of the order of 0.1 millisecond. With flash tubes such as are obtainable, it is possible to get a flash illumination with 1,000 amps. peak current, of the order of 20 million lumens. If we take that for 0.1 ms. we get 2,000 lumen-seconds per flash, which compares reasonably well with the 2,400 for the arc lamp.

On a rough basis, therefore, the light is more than adequate ; but we have so far taken no consideration how that light is to be collected. With the shape of the arc lamp source the means of collection is comparatively simple. But in the flash discharge lamp the discharge usually takes the form of a thin column of 10 cm. length and inappreciable width. This presents a difficult problem of collection and projection upon the film gate.

Another consideration is that the output of 20 million lumens is based on flashes at rare intervals. There is quite an amount of energy to be dissipated before the next flash, otherwise the heat builds up. If frequent flashes are needed with existing tubes, the power must be reduced appreciably.

Another drawback, so far as continuous projection is concerned, is that in the conventional projector the frame is flashed twice ; with a continuously moving film, the flash can be accurately positioned at only one precise instant. The timing of the flash must be very accurately controlled, to within 0.1 ms., and accurately synchronised with the film. Fundamentally there can be only one screen illumination per frame, which would cause a very marked flicker, which might be accentuated by the fact that the period of light to dark is about 1 : 9999.

But some consideration is being given to the use of these illuminants with conventional types of projectors, using 48 flashes per second. With a conventional projector, the difficulty of the ratio between light and dark

* General Electric Co., Ltd.

could perhaps be overcome by increasing the number of flashes per frame.

Apart from the flash discharge lamp, there is, of course, the work that is going on in regard to the use of the compact source lamp for film projection, and of this we hope to hear more on another occasion.

Mr. S. B. SWINGLER : What is the colour of the light from a discharge tube?

Mr. WALTERS : I imagine that at these extremely high intensities, the colour is very good. With the present type of compact source lamp, continuously rated, there is, of course, a colour problem.

Mr. L. KNOPP : In regard to the period of eclipse as compared with the illuminating period, am I not correct in stating that when projecting a television picture at the rate of $2\frac{1}{2}$ mc./s, the electronic stream in building up the television picture is striking one particular point of the screen for a period of time infinitely smaller than $1/10,000$ th second?

Dr. F. S. HAWKINS : The answer is that the afterglow of the screen is quite an appreciable period.

Mr. L. KNOPP : I rather anticipated that answer—which brings me to my second point : why not a fluorescent kinema screen?

Mr. WALTERS : I think that is an excellent idea.

Dr. HAWKINS : If we have a fluorescent screen, what we are going to energise it with? The energising medium must be of greater frequency than the fluorescence, therefore to get white light we should need ultra-violet.

FILM MUTILATION AND THE 2,000ft. REEL

G. A. Jackson, M.B.K.S.*

What has been the effect on film damage of the partial adoption of the 2,000ft. reel?

I AM unable to quote official figures that would give a clear indication of the ratio of damage as against the single reel which is ultimately doubled up by the projectionist. I can, however, state that so far as G.-B. is concerned, the number of recorded investigations of damage in connection with the double reel compares favourably with those of the single reel.

Some time ago facilities were placed at the disposal of a renting firm, so that a full history and statistical survey could be compiled in respect of copies of a Technicolor film sent out with the reels doubled. This research proved that undoubtedly the value of the double reel, so far as length of life and freedom from damage was concerned, was very considerable.

The main difficulty would appear to be the extra weight of the double reel, which often causes the centre to collapse while the reel is in transit, and it may arrive at its destination with the inner layers cracked. In many cases, reels have been sent out from the laboratories with bakelite cores inserted as a protection against this type of damage. Unfortunately, however, it is not possible for the projectionist to re-insert the core when returning the film, as the bakelite core is not adaptable to the standard plating-off spindle. Personally, I favour the wood bobbin used by some renting firms, but the diameter of this bobbin is $\frac{3}{4}$ in., whereas the diameter of the plating-off spindle is about $\frac{11}{16}$ in., so that there is again some excuse for the projectionist not re-inserting the bobbin when returning the film.

Mr. A. E. ELLIS : The distribution of the double reel has reduced mutilation very considerably. The perforations are free from damage; in the past, when joints have been made out of alignment, the sprocket teeth have damaged the perforations—that form of damage has almost disappeared. Occasionally we have complaints that makers' joints give trouble. Some laboratories are using a negative type of join on positive film.

In the case of my own companies, 90% of the output is in double reels. We have

been fortunate in getting supplies of cans.

Regarding the remark about centres cracking, the double-reel cans have to be put in the transit cases vertically, therefore, if transit cases are dropped, the impact on the centre is terrific. We consider bakelite bobbins useless; we insert a section of $\frac{3}{4}$ in. hard-wood dowelling.

In course of the discussion Mr. Swingler demonstrated a spool designed by Miss Dawn Cox, a feature of which was the provision of sleeves of different diameters, to suit varying bores of reels.

TECHNICAL ABSTRACTS

Most of the periodicals here abstracted may be seen in the Society's Library

THE METAL DIAZONIUM SYSTEM FOR PHOTOGRAPHIC REPRODUCTION.

R. J. H. Alink, C. J. Dippel, and K. J. Keuning, *Philips Technical Review*, Vol. 9, No. 10, 1947/48.

This paper describes some technical details of the system previously described.* A carrier, *e.g.*, Cellophane 40 μ thick, is impregnated with a mixture of a diazonium compound and a metal salt, *e.g.*, o. cresol diazonium sulphonic acid and mercurous nitrate. On exposure to light metallic mercury forms a faint image, which is physically developed in a normal physical developer. The gamma obtained varies both with the moisture content and the intensity of the exposing light, but may be very high (6 to 7).

A printing machine is referred to on which the carrier is sensitized, dried and printed, and means are envisaged whereby the same material might receive two exposures, for picture and sound, being so treated that quite different gammas are obtained. M. V. H.

NEW THREE-COLOUR CAMERA.

J. H. Coote, *J. Soc. Mot. Pic. Eng.*, June, 1948, p. 543.

The British Tricolour camera† is of the "bi-pack and one" type, with beam-splitter prism. Vinten "Everest" intermittent motions are employed, arranged at right angles, one gate pivoting sideways for threading. Methods of adjusting the optical system, and of checking its accuracy to within very fine limits are described. Remote control of focusing is provided. R. H. C.

U.S. NAVY DEVELOPS SUPER-SPEED CAMERAS.

Amer. Cinematographer, June, 1948, p. 207.

The Zarem camera is capable of an exposure of 100,000,000th of a second, and employs the principle of the Kerr cell. The Bowen camera employs a rotating mirror in conjunction with an arc of fixed lenses; it is capable of exposing 76 pictures at a rate of 400,000 per second. R. H. C.

ELECTRONIC TRICK-WORK.

A. Barret, *Technique Cinématographique*, June 24, 1948, p. 299.

A device now in course of development, known as the Teletruc, permits of carrying out the usual forms of special effects electronically. The scenes are registered upon two television cameras, and are reproduced upon the screen of a cathode-ray tube through circuits which enable either scene to be superimposed upon the other, and also allow scenes to be enlarged, reduced, distorted, etc. The tube image, when reproduced to the satisfaction of the operator, is photographed. R. H. C.

ELECTRICAL CHARACTERISTICS FOR THEATRE SOUND SYSTEMS.

A.M.P.A.S. Bull., Apr., 1948.

Of particular value to installation engineers, the bulletin (supplementing that published in 1938) sets out optimum auditorium specifications in respect of amplifier power, speaker power handling capacity, electrical characteristics, speaker input adjustment, and back stage acoustical treatment. N. L.

VERSATILE NOISE-REDUCTION AMPLIFIER.

Kurt Singer, *J. Soc. Mot. Pic. Eng.*, June, 1948, p. 562.

Circuit and performance details are given of a new unit, designed to provide envelope current for either shutter or biased galvanometer recorders. N. L.

SYNTHETIC SOUND ON FILM.

Robert E. Lewis and Norman McLaren, *J. Soc. Mot. Pic. Eng.*, March, 1948, p. 233.

Methods of producing synthetic sound-tracks are described under three classifications: hand drawing on film, photography from drawings, and generation by machine aid. Practical details for controlling of volume, timbre and pitch are given. N. L.

* *Philips Tech. Rev.*, Vol. 9, No. 3, 1947.

† See *British Kinematography*, Oct., 1947, p. 123.

LIGHT MODULATION BY P-TYPE CRYSTALS.

G. D. Gotschall, *J. Soc. Mot. Pic. Eng.*, July, 1948, p. 13.

A method of obtaining the Kerr effect is explained, using crystals of the phosphate family as the electro-optic cell. A typical modulator unit suitable for variable density recording is described. N. L.

THEATRE DIMMERS.

D. M. Rollins, *J. Soc. Mot. Pic. Eng.*, June, 1948, p. 607.

The author discusses the merits of various types of dimmer suitable for the control of motion picture house interior lighting. The three types discussed are Resistance, Reactance, and lastly but mainly a new type—the Autotransformer dimmer. This dimmer is suitable for flickerless dimming of all usual types of electric illuminant including cold cathode lighting. The overall efficiency of the unit is exceptionally high when compared with other types, and it is now available in single units with up to 8,000 watts capacity. Various methods of mounting and operation are discussed including remote controlled operation. F. T. J.

NEW TECHNIQUES IN BLACK LIGHT.

Ronald J. Elliot, *J. Soc. Mot. Pic. Eng.*, June, 1948, p. 601.

A new style of motion picture theatre internal decoration is described, which takes the form of mural plaques painted with fluorescent material, and excited by ultra-violet light supplied by high-pressure mercury-vapour black glass lamps. Methods of manufacture and the economics of the newly introduced "prefabricated" murals are discussed giving the size and number of lamps required to excite a given area of mural. F. T. J.

NEW CIRCULAR FLUORESCENT LAMP.

Eugene W. Beggs, *J. Soc. Mot. Pic. Eng.*, June, 1948, p. 593.

The author describes a new development in fluorescent lighting in the form of a half-circle tube. Dimensions, technical data and operation details for A.C. and D.C. circuits are given. Several interesting applications for these tubes are described, such as lighting for ticket sales booths, decorative ceiling fixtures and picture lighting. F. T. J.

LIGHTING IDEAS OFFERING NEW OPPORTUNITIES IN THE THEATRE.

C. M. Cutter and R. T. Dorsey, *J. Soc. Mot. Pic. Eng.*, June, 1948, p. 571.

New lighting ideas are suggested using Slimline and Circline lamps. Full operating details and dimensions are given, as well as designs for numerous fittings, which are allied to the motion picture theatre. The reflector lamp is also described; this lamp has a reflecting surface silvered on the inside of the bulb, so that all deterioration of the reflector by dust, dirt and corrosion is eliminated. F. T. J.

THE COUNCIL

Meeting of Oct. 6th, 1948

Present: Messrs. W. M. Harcourt (*President*), A. W. Watkins (*Vice-President*), L. Knopp (*Deputy Vice-President*), P. H. Bastie (*Hon. Treasurer*), I. D. Wratten (*Past President*), H. S. Hind, R. E. Pulman, F. G. Gunn, R. B. Hartley, A. G. D. West, R. H. Cricks (*Technical Consultant*), W. L. Bevir (*Secretary*).

Patron Membership.—It was reported that Messrs. Ross, Ltd., and Messrs. Dufay-Chromex, Ltd., had agreed to become Patron Members of the Society.

Papers Committee.—Mr. Knopp reported that the season's programme had been arranged, with the exception of the Newman Memorial Paper. The presentation of a medal to the author of the best paper during Mr. Wratten's term of office was referred to the Papers Committee.

Library Committee.—Mr. Rex Hartley reported that the Library Catalogue was completed and would be despatched in November.

Co-operation with A.F.I.T.E.C.—A joint letter from the Association Française des Ingénieurs et Techniciens du Cinéma, and the Associazione Technica Italiana per la Cinematografia, was referred for action to the Foreign Relations Committee. Mr. Cricks was asked to acknowledge it on behalf of the President.

B.S.I.—Messrs. Cricks, Pulman and Ricketts were nominated to serve on the British Standards Committee on 35mm. Sound and Picture Projectors.

EXECUTIVE COMMITTEE

Meeting of October 6th, 1948

Present : Messrs. W. M. Harcourt (*President*), L. Knopp (*Deputy Vice-President*), I. D. Wratten (*Past President*), P. H. Bastie (*Hon. Treasurer*), W. L. Bevir (*Secretary*) and Miss S. M. Barlow (*Assistant Secretary*).

Elections.—The following were elected :—

TERENCE ALBERT BARTLETT (Member), Cine-Technic.

ALAN N. DAVIES (Associate), H. D. Moorhouse Circuit.

ERIC SPENCER HALL (Member), British Thomson-Houston Co., Ltd.

JOHN ALFRED DECIMUS O'GORMAN (Member), British Lion Studio Co., Ltd.

GORDON THRIPP (Associate), London Film Studio, Ltd.

DEREK GUTHRIE ROBERTS (Associate), Odeon Cinemas, Ltd.

RONALD CLIVE THOMAS (Associate), Hoyts Theatres, Ltd., Australia.

ROBERT ARTHUR LALLY (Student), RCA Photophone, Ltd.

GORDON ALFRED STOCKER (Associate), RCA Photophone, Ltd.

M. V. KRISHNASWAMY (Student), G.-B. Instructional.

HARRY WATT (Member), Ealing Studios, Ltd.

EDWARD CHARLES BRUNGER (Associate), Pathéscope, Ltd.

Resignations.—The following resignations were accepted with regret :—

L. J. HIBBERT (Member). Miss M. H. ROBERTSON (Associate).

B.S.I.—The payment of the annual subscription to the British Standards Institution was approved.

AMERICAN EXPOSURE METER STANDARD

A standard method of calibrating exposure meters to assure comparable results and to give photographers better service is described in American Standard Z38.2.6-1948. In conjunction with the standard method of determining film speed and of expressing film speed in terms of standard exposure index numbers, it assures the advantages of uniform markings, standard calibration, uniform exposure index numbers, and minimum requirements for accuracy and performance of exposure meters.

B.K.S. LIBRARY

Recent extensions in the B.K.S. Library have been recorded in the form of a film, in which Rex B. Hartley, chairman of the Library Committee, announces the developments. The film (the sound on which has been recorded by the kindness of Metro-Goldwyn-Mayer British Studios, Ltd.) will be shown for the first time at the B.K.S. meeting on December 1st, when Mr. W. M. Harcourt will deliver his Presidential Address.

SUBSCRIPTION RATES

The annual subscription rate to *British Kinematography* will in future be 37s. 6d., to include postage.

PERSONAL NEWS of MEMBERS

Members are urged to keep their fellow members conversant with their activities through the medium of British Kinematography.

RONALD W. BAKER has established a B.K.S. branch library in his offices at the Wälturdaw Cinema Supply Co., Ltd., 37, Bath Lane, Newcastle-on-Tyne. The books available on loan to members are, as yet, few in numbers, but they are supplemented by B.S.I. Standards on all subjects related to kinematography. Books may be borrowed for one month, and the library is open between 10 a.m. and 5 p.m. on weekdays; closed Saturdays.

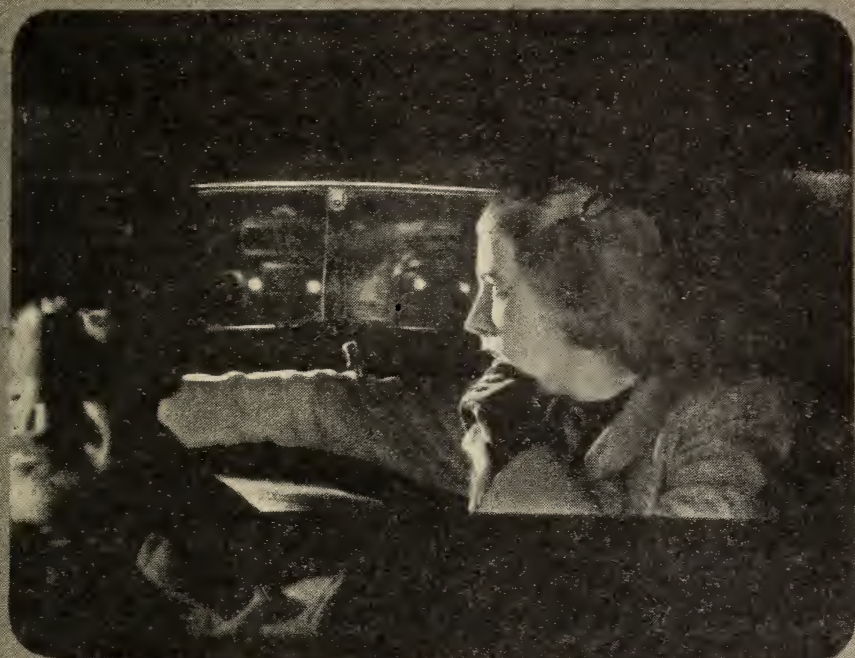
G. H. BARNEY is with the Army Kinema Corporation, and in charge of projection at the "Globe" Cinema, Europa, Gibraltar.

W. V. DE WAN is now District Engineer, stationed at Sheffield, of the Circuits Management Association, Ltd.

The Eastman-Kodak Co. announces the death of Dr. S. E. SHEPPARD, on September 29th, at the age of 66 years. Dr. Sheppard, who was born in Kent, was assistant director of research at Rochester and was responsible for much fundamental photographic research.

It is particularly requested that changes of address should be notified immediately to the Secretary, in order to obviate non-delivery of *British Kinematography* and other communications.

Small announcements will be accepted from Members and Associates. Rate, 4d. per word, plus 2s. for Box No. if required (except for Situations Wanted). Trade advertisements, other than Situations Vacant, not accepted.



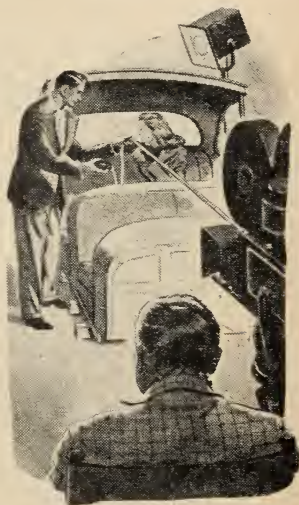
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LECTURE PROGRAMME

December, 1948

Meetings to be held at the Gaumont-British Theatre, Film House, Wardour Street, London, W.1, commencing at 7.15 p.m. Sub-Standard meetings in the G.-B. Small Theatre.

S—Sub-Standard Film Division.

F—Film-Production Division.

Dec. 1 **PRESIDENTIAL ADDRESS**, by W. M. HARCOURT, F.B.K.S., F.R.P.S., F.R.S.A.

S Dec. 8 **"Making Educational Films—A Discussion on the Particular Requirements,"** by FRANK WELLS.

F Dec. 22 **"Make-up in Relation to the Photographic Emulsion,"** by ERNEST TAYLOR.

MANCHESTER SECTION.

Meeting to be held at the Lecture Theatre of the Manchester Geographical Society, 14 St. Mary's Gate, Parsonage, Manchester, commencing at 10.30 a.m.

Dec. 7 **"Screen Illumination with respect to the Carbon Arc,"** by H. DUERDOTH, B.Sc., M.B.K.S., A.R.C.S.

NEWCASTLE-ON-TYNE SECTION.

Meeting to be held at the Lecture Theatre, Newe House, Pilgrim Street, Newcastle-on-Tyne, 1, commencing at 10.30 a.m.

Dec. 7 **"Coloured and Directional Lighting as applied to the Stage,"** by P. CORRY.

LEEDS SECTION.

Meeting to be held at the Y.W.C.A., Cookridge Street, Leeds, 1, commencing at 10.30 a.m.

Dec. 4 **"Auditorium Requirements in Sound-Film Presentation: Part II—Acoustics,"** by LESLIE KNOPP, Ph.D., M.I.E.E., F.B.K.S.

BRITISH FILM ACADEMY.

Invitations may be obtained from the B.K.S. for the following meeting, to be held at the Gaumont-British Theatre at 8.30 p.m.

Dec. 3 Debate. **"Film Censorship."** Speakers:—

For the B.B.F.C., A. T. L. WATKINS.

For the Film makers, FRANK LAUNDER.

Chairman, SIDNEY BERNSTEIN.

Requests from non-Members for invitations to the above meetings should be accompanied by stamped addressed envelope.

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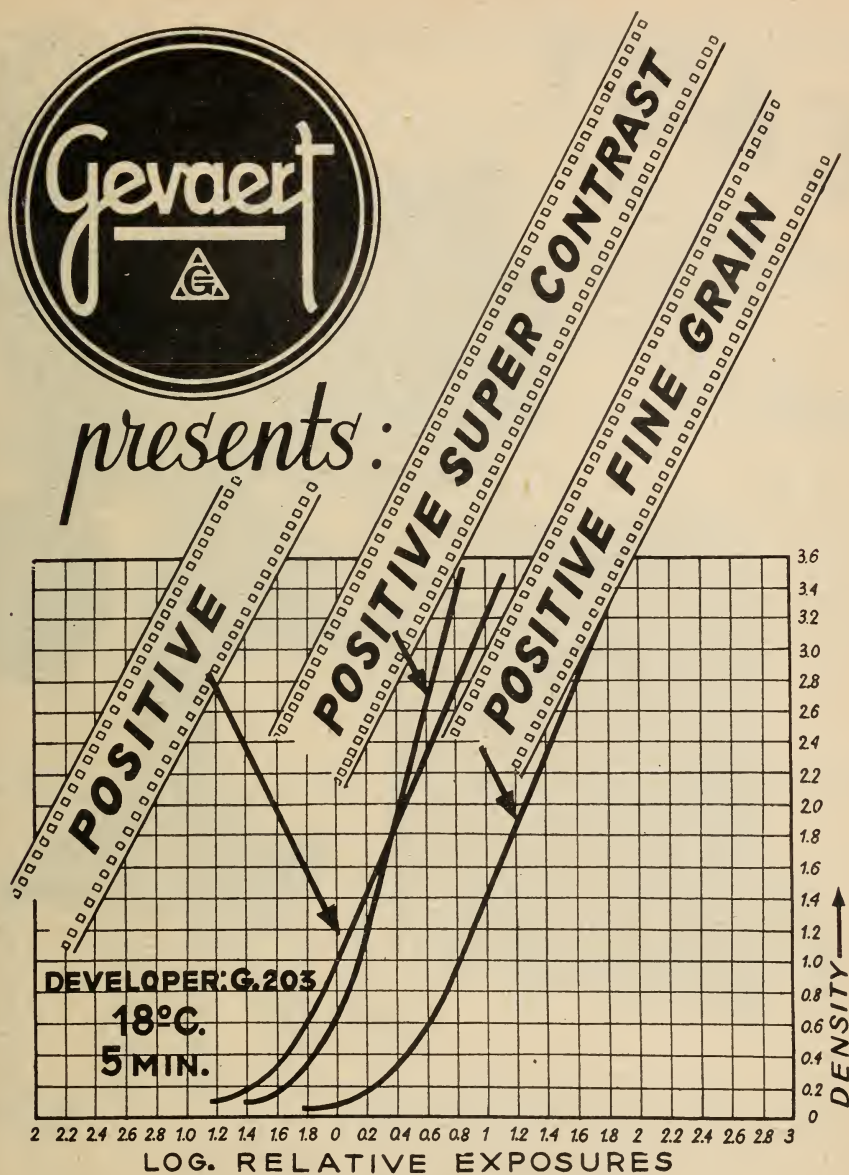
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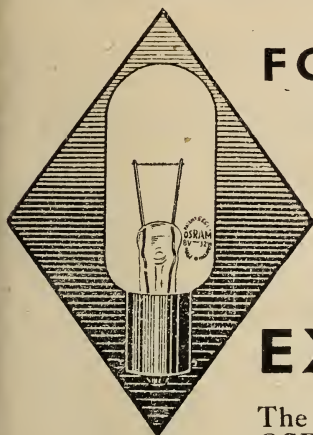
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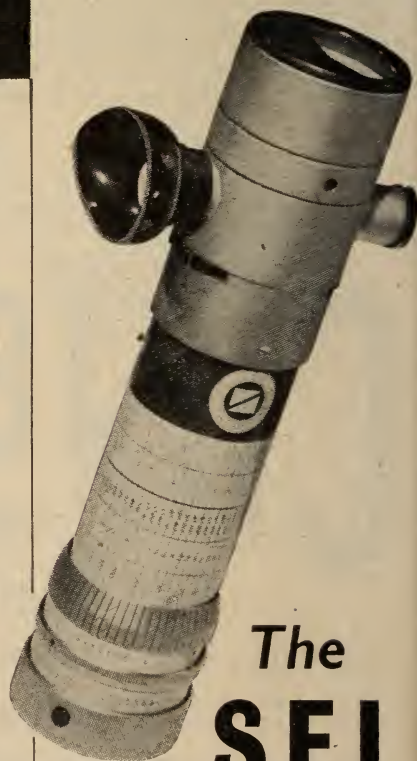
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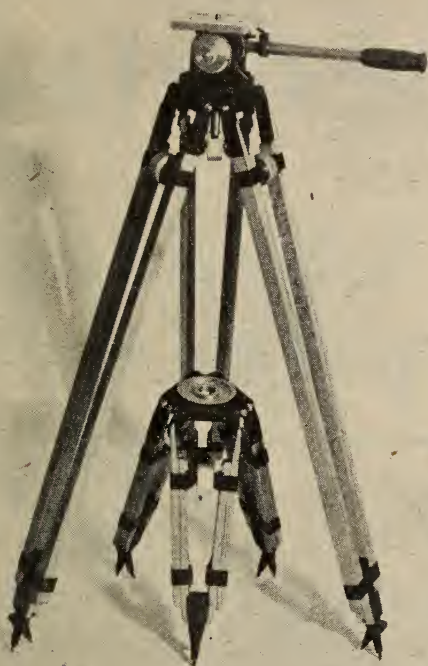
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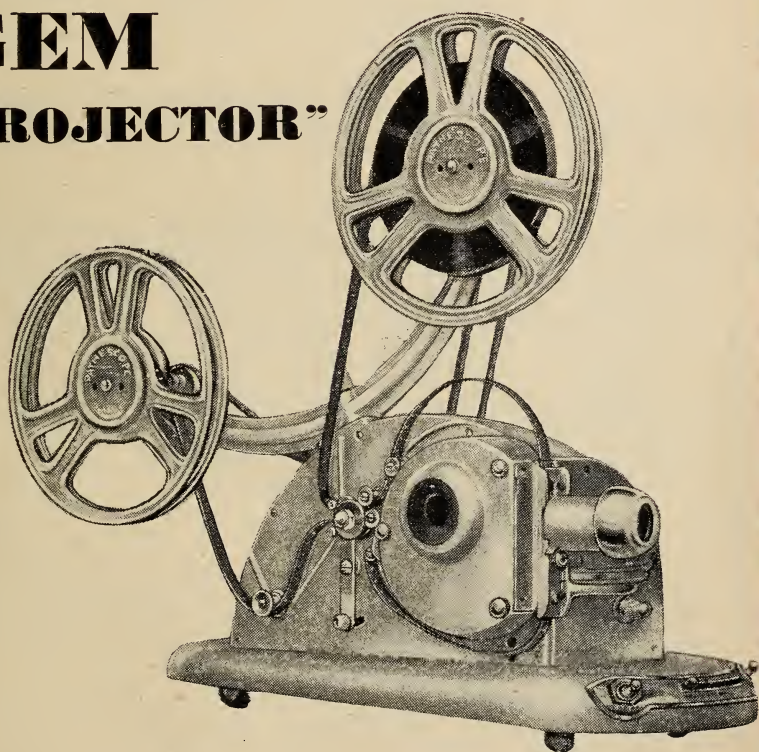
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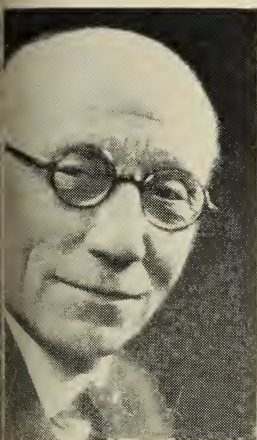
BRITISH KINEMATOGRAPHY

The Journal of the British Kinematograph Society

VOLUME THIRTEEN, No. 6.

DECEMBER, 1948

NEWLY ELECTED HON. FELLOWS AND FELLOWS



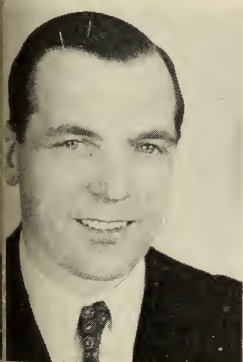
WILLIAM G. BARKER



CECIL M. HEPWORTH



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F. G. GUNN

On the occasion of the Presidential Address on December 1, 1948, announcements were made of the conferment of the Honorary Fellowship upon Messrs. William G. Barker, Cecil M. Hepworth and Ian Denis Wratten, and of the Fellowship upon Messrs. F. G. Gunn, M. V. Hoare, T. W. Howard, F. N. G. Leever, and F. A. Young.

The citations will be found on page 206.

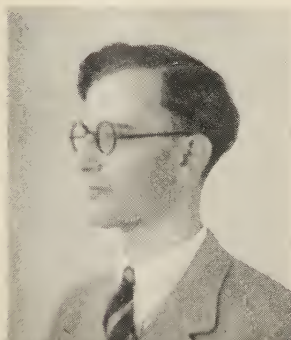


M. V. HOARE

T. W. HOWARD



F. N. G. LEEVERS



F. A. YOUNG



LECTURE PROGRAMME—SPRING, 1949

Meetings (except that of May 7) to be held at the Gaumont-British Theatre, Film House, Wardour Street, London, W.1., commencing at 7.15 p.m., Sundays, 11 a.m. Meetings of the Sub-standard Film Division in the G.-B. Small Theatre.

SOCIETY MEETINGS.

- Jan. 5 *Newman Memorial Lecture*. "TRANSMISSION CALIBRATION OF LENSES," by A. WARMISHAM, M.B.K.S. (*Joint meeting with the Royal Photographic Society.*)
 Feb. 2 "THE KINEMA AND TOWN AND COUNTRY PLANNING," by CLIVE WILLIAMS, B.Com.
 Mar. 2 "CLOSED-SEQUENCE ELECTRONIC CONTROL SYSTEMS," by A. PORTER, M.Sc., Ph.D.
 Apr. 6 *Annual General Meeting*. "DEVELOPMENTS IN MAGNETIC SOUND-ON-FILM," by Dr. O. K. KOLB, M.B.K.S. (*Joint meeting with the British Sound Recording Assoc.*)

THEATRE DIVISION MEETINGS.

- Jan. 16 *Modern Kinema Equipment* : 2—B.T.H. Supa.
 Mar. 20 *Modern Kinema Equipment* : 3—Ross RCA.
 Apr. 24 *Annual General Meeting*. "Discharge Lamps in Relation to Film Projection," by A. G. PENNY, F.I.E.S., M.B.K.S., preceded by a film, "Let Us See," by courtesy of the Illuminating Engineering Society.

SUB-STANDARD FILM DIVISION MEETINGS.

- Feb. 9 "Current Practice in 16mm. Sound Printing," by M. V. HOARE, B.Sc., F.B.K.S., F.I.B.P.
 Apr. 13 *Annual General Meeting*. *Review of New Apparatus.* (*Joint meeting with the Royal Photographic Society and the Scientific Film Association.*)

FILM PRODUCTION DIVISION MEETINGS.

- Feb. 23 "Motion Picture Photography," by F. A. YOUNG, F.B.K.S., F.R.P.S.
 Apr. 27 *Annual General Meeting.*
 May 7 *Visit to A.B.P.C. Studios, Elstree.*

JOINT MEETINGS WITH A.C.T.

- Jan. 26 "The Application of Music to Films," by HUBERT CLIFFORD, B.Sc., D.Mus., Hon. R.A.M.
 Mar. 23 "Independent Frame Production," by DAVID RAWNSLEY and J. WILSON.
 May 25 "Thirty Years of British Film Production," by Sir MICHAEL BALCON.

MANCHESTER SECTION MEETINGS.

Meetings to be held at the Lecture Theatre of the Manchester Geographical Society, 14 St. Mary's Gate, Parsonage, Manchester, commencing at 10.30 a.m.

- Jan. 4 "Nitrate and Safety Film-Base Characteristics," by G. J. CRAIG, O.B.E., M.B.K.S.
 Feb. 1 "Time Base, its Implications," by J. C. EVANS.
 Mar. 1 "Cathode Glow Tube and Crater Arc," by Dr. J. A. DARBYSHIRE, M.S.Inst.P.
 Apr. 5 "Glass in Projection Systems," by Dr. WILLOTT.
 May 4 *Discussion Meeting.*

LEEDS SECTION MEETINGS.

Meetings to be held at the Y.W.C.A., Cookridge Street, Leeds 1, commencing at 10.30 a.m.

- Jan. 8 "Home Office and Local Regulations," by J. BARNETT.
 Feb. 5 "Kinema Projector Design," by R. ROBERTSON, B.Sc., M.I.Mech.E., M.B.K.S.
 Mar. 5 "Light Production from the Carbon Arc," by H. P. WOODS, B.Sc., A.Inst.P., M.B.K.S.
 Apr. 2 "Film Projectors for Television," by A. BUCKLEY.
 May 7 "Bloomed Lenses," by D. F. BURNETT, M.A., A.Inst.P.
 June 4 *Brains Trust.* A panel of experts will answer questions.

NEWCASTLE-ON-TYNE SECTION MEETINGS.

- Jan. 4 "Breakdowns on Electrical Machinery," by W. A. BURTON.
 Feb. 1 "Developments in Discharge Tube Lighting," by G. KINGSLEY LARK.
 Mar. 2 "Television Picture Projection," by G. DOBSON.
 pr. 5 "Reflectors, Types and their Uses," by F. F. TRELIVING.
 May 3 "Heating and Ventilation," by L. H. HENTON, A.M.I.H.V.E., M.B.K.S.
 June 7 *Discussion Meeting.*

DEVELOPMENT OF THEATRE TELEVISION IN ENGLAND

A. G. D. West, M.A., B.Sc., Hon. F.B.K.S.*

Read to the Society of Motion Picture Engineers on October 21, 1947, and abridged from the August, 1948, issue of that Society's Journal.

I. INTRODUCTION

TELEVISION enthusiasts (we shall call them "tele-visionaries") who have made a close study of the commercial possibilities of the use of television for the entertainment of kinema audiences, have forecast that, provided a broad co-operative view is taken by all the various entertainment interests, including those which promote sporting and similar events, opportunities for expansion in the entertainment industry can be considerable, and would fully justify the wildest dreams of the most imaginative exploiters in the entertainment field.

The following observations aim at giving a review of the position of theatre television in Britain, and a summary of the aims of the technician in preparing for full commercial use large-screen television equipment, and the means whereby programmes can be provided for such an equipment, together with a statement of the various aspects which will need to be considered in detail by the exhibitor, between now and such time when commercial equipment will be available on the market. The paper is concerned only with black-and-white projection. We have nothing as yet to show on colour.

II. REVIEW OF PROGRESS UP TO 1939

The beginning of official transmission of television in England was due to the dogged persistence of John Logie Baird, who, as a result of his experiments and demonstrations, over the period from 1923 to 1928, was able to get the British Broadcasting Corporation to radiate vision signals, first in 1929 by an experimental service, and later, from August, 1932, in the form of a regular programme service. The low-definition broadcast service ceased in September, 1935, and its place was taken by regular transmissions from the new television station at the Alexandra Palace, London, on a 405-line interlaced standard developed by the Marconi and Electrical and Musical Industries companies.

Large Screen Demonstrations

Large-screen television was first demonstrated to the public in Great Britain by John Logie Baird in 1930 at the London Coliseum Variety Theatre, when he used a screen of 2,100 lamps, operated by a mechanical commutator switch to provide a picture 30 by 70ins. in size. This novelty was retained in the theatre programme for three weeks, and, therefore, we are justified in saying that it excited considerable interest, although the definition was crude, but the brightness was adequate. An extension of this system was demonstrated in Berlin by Karolus, who employed a bank of 10,000 lamps arranged in a square frame of 100 horizontal rows, each containing 100 lamps¹.

At the same time the old mechanical methods were pushed to the limit, and in June, 1932, Baird gave a demonstration of the Derby in a London theatre using a three-channel transmission over a distance of 25 miles, each channel providing 10 lines of a 30-line picture 9in. by 6ft. in size. The projector consisted of a mirror drum with Kerr-cell modulation of the light.

*Cinema-Television, Ltd.

Early Colour Demonstrations

Before leaving the reference to these mechanical systems, we must mention the first large-screen colour demonstration in Great Britain, which was presented by Baird as part of a variety programme in the 3,000-seat Dominion Theatre in 1938. Looking back at that demonstration, in which a two-colour process was employed in providing a 120-line interlaced picture, we find that the results were remarkable, considering the state of the art at that time.

The intermediate film process, which was developed both in Britain and Germany, and demonstrated to theatre audiences in 1935, has the advantage that it is possible to provide the normal standard of brightness on the theatre screen, because the processed film passes through a standard projector.

However, further development of this process was dropped and efforts were concentrated on the cathode-ray-tube projection method, which appeared to offer the most scope for future practical development. It formed the basis of the equipment developed by the Baird Company for installation in 1938 and 1939 in the theatres of the Gaumont-British Picture Corporation.

Theatres Equipped and Programmes Provided

Early in 1938, a small projector was installed in the Tatler Newsreel Theatre¹. It housed a cathode-ray tube operating on 30,000 volts, and reproduced an intensely bright picture (3 by 4 in. in size) on the screen of the cathode-ray tube, which was projected by an $f/2.5$ lens on to a screen 10 by $7\frac{1}{2}$ feet. The illumination on the theatre screen was of the order of $\frac{1}{4}$ -foot-candle, and the brightness, using a semi-reflecting screen material, of the order of $\frac{1}{2}$ foot-lambert; and demonstrations were given of various actuality programmes transmitted on the 405-line basis by the B.B.C.

Early in 1939 the Marble Arch Pavilion, with a seating accommodation for 1,290 persons, was equipped with a higher power, dual cathode-ray-tube projector, using the pipe-shaped tube with metal-backed fluorescent screen, operating on 60,000 volts, with a Taylor-Hobson $12\frac{1}{2}$ in. $f/1.5$ anastigmatic lens². This provided an illumination of $\frac{1}{2}$ foot-candle on a screen 15 by 12 feet with a brightness of 1 foot-lambert in the high-lights.

By September, 1939, the following theatres had been equipped with these projectors:

Marble Arch Pavilion	...	1,290 seats
New Victoria Kinema	...	2,564 seats
Gaumont, Haymarket	...	1,382 seats
Gaumont, Lewisham	...	3,047 seats
Tatler Theatre	...	650 seats

The incidence of war prevented the equipping of other theatres and thus the plan to have selected television programmes presented at twelve London theatres to a total audience capacity of approximately 22,000 was never realised.

At the same period Scophony, Limited, with its optical mechanical system with the supersonic light valve, equipped the Odeon Theatre, Leicester Square, 2,116 seats³, and certain news theatres, and were attracting full audiences for special programmes.

III. REQUIREMENTS FOR A THEATRE SERVICE

Before continuing with the historical development since the war, I would like to discuss briefly the requirements for a theatre television service.

The Complete Theatre System

It is the ultimate aim of the television engineer to provide the entertainment industry with a complete television system which can handle and

distribute all types of programme material which will be of interest. The system and the equipment utilised therein can be conveniently divided as follows :

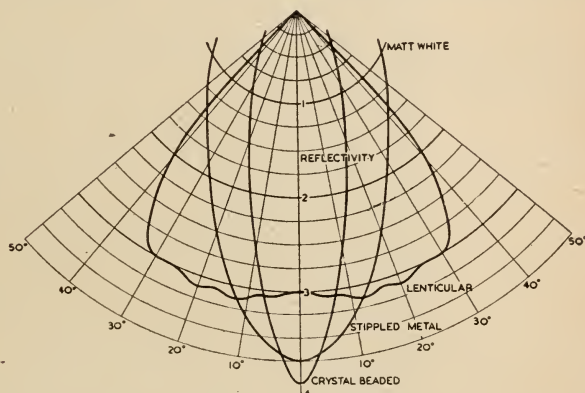
- (a) Pickup equipment consisting of cameras and associated equipment for synchronising control for interior (such as studio and dramatic presentations) and for exterior (outdoor scenes) together with the necessary sound pickup, lighting, and power supply.
- (b) Film-scanning equipment.
- (c) Control-room equipment, for the purpose of selection and routing of programmes.
- (d) Distribution network, utilising special cables or high-frequency radio channels.
- (e) Theatre television projectors and loudspeakers.

The charter or ideal for British theatre television engineers is a system of pick-up, control, distribution, and theatre reproduction which is capable of dealing with events taking place mainly in the London area, and of distribution not only to theatres in London but also in the provinces. At the same time it comprises provincial programme sources also⁵.

Comparison with Film Projection

The overriding problem is, of course, the development of theatre television projection to a form comparable to the present-day film projection.

Fig. 1. Polar diagrams showing reflectivity of types of screens at various angles with the normal to the screen, compared with that of the matt white screen which is represented by the circle of radius 1.



Such a programme of work can conveniently be visualised in two stages :

- (1) The attainment of the utmost possible performance in each link of the 400- or 525-line system; alternatively the maximum possible to the 3-megacycle bandwidth limit.
- (2) The full equivalent to film projection (say 1,000-line basis or 20-megacycle bandwidth, or whatever it may be found to be).

The exhibitor or promoter is our customer, and he presumably is capable of visualising a true representation of what the public will require. It is our duty to satisfy him, if he wants it, by providing :

- (1) Instantaneous projection in theatres, from a given distribution centre, of items of entertainment, of interesting events and actualities.
- (2) Delayed presentation from the distribution centre. For example, daily films of local interest which are applicable to the theatres in a local area.
- (3) Delayed presentation in individual theatres where the programme planning is impracticable to admit of (1), or requires re-presentation additional to that given by (2).

All these needs must be provided with the qualities of normal film projection. There may be, there are sure to be, other requirements as well, but for the moment we, as technicians, have many problems to solve (even in black-

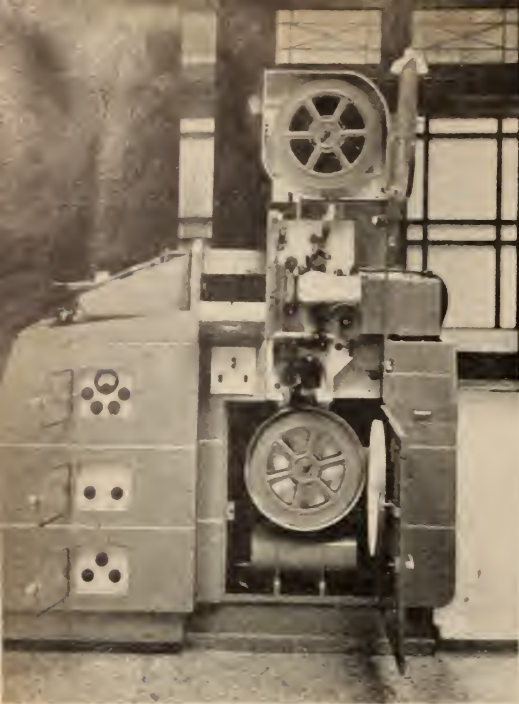


Fig. 2. "Cintel" flying-spot (35 mm.) film scanner with doors open and cover removed. Scanning Tube on left, Optical System, Gate, and Photo-cell in centre.

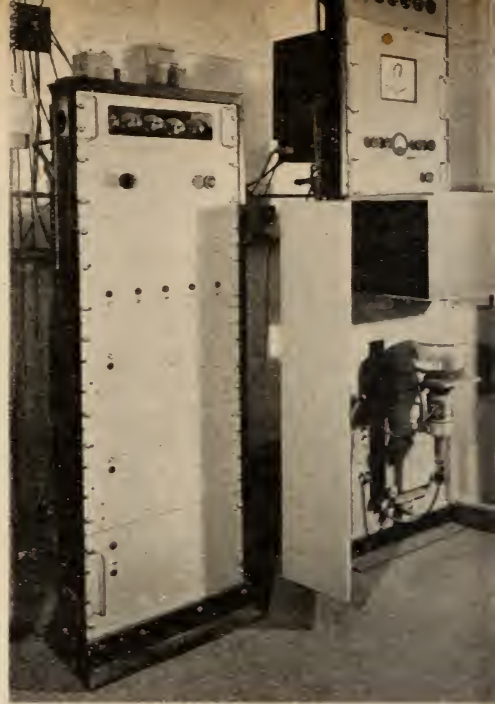


Fig. 3. "Cintel" flying-spot caption scanner. Scanning tube below, lens and phototube box in centre, monitor tube above.

and-white only), and they will take time. However, I must emphasise that the theatre owners and exhibitors must also spend this period usefully in studying the possibilities and limitations of the application of television and in trying to decide how they want to use it as a means of entertaining, attracting, and even educating the public.

It may be three years or it may be more before we can provide the brightness and definition in the quality of the picture which will be necessary, for the exhibitor to mingle his television with his film programme; but it may be that he will find it profitable to consider an intermediate step whereby the television programme can stand on its own merit without achieving the full technical results of the film projection, and by segregating the television from the film programme, or the television theatre from the film theatre, can give us an opportunity of gaining practical experience in the new technique. It may well be, on the other hand, that the new art will not be restricted to such applications, but will break out, with success, in an entirely new medium of application, which we have so far not visualised.

I look forward to a more careful consideration of all the points by those who are responsible for the provision of public entertainment, and by such people who have the imagination and initiative to make practical use of the new tool which is now being forged.

IV. POSTWAR DEVELOPMENT

The keynote of the resumption of work on television in the autumn of 1945 was set by the British Government Television Committee, which issued a report in that year setting forth its deliberations regarding the reinstatement and development of the television service after the war, with special consideration given to (a) the extension of the service to the larger centres of population, (b) encouragement of research and development, and (c) guidance to manufacturers of equipment.

This report was accepted by the British Government and issued in the form of a white paper, but since that date no official pronouncement has been given indicating that these recommendations have been implemented in any way, or that any steps have been taken to give effect to them or to encourage the kinema industry in its work on these problems.* I shall deal further with this point later on, but for the moment I should prefer to submit to you details of the work which has been done by commercial companies, and in particular by my own Company with the encouragement of Mr. J. Arthur Rank, and of the results achieved in the two years since we started thinking about television again in the autumn of 1945. During this period, we have seen the development and application of many new types of equipment which have an important bearing on our work; for example, new types of television cameras, of scanners for film and still pictures, new means of distribution by radio or by cable, and theatre projectors either of the cathode-ray-tube type with lens and mirror systems, or of the intermediate film type, or of the storage type.

Comparison with Kinema Standards

Before considering these in detail, let us consider five main headings



Fig. 4. Still picture transmitted on 405-line basis by "Cintel" caption scanner.

(which possibly can be regarded as separate factors, but which in practice are all interlinked), to provide a basis of comparison with the accepted standards of the kinema.

- (1) Picture definition, or detail of the reproduced picture.
- (2) Picture quality or faithful reproduction of the tone values, from black through the half-tones to white.
- (3) Brightness of the reproduced picture, and its colour.
- (4) Freedom from interference, flicker, spurious patterns and effects, shading, and background noises.
- (5) Cost of manufacture of the equipment and of its installation and maintenance.

Performance of Equipment

Let us now make a brief review of the various types of equipment already developed on both sides of the Atlantic, demonstrated in England, and also able to be manufactured.

*Since the paper was presented, a certain amount of progress has been made towards implementing the report.

(a) *Cameras.* You are quite familiar with the operation and characteristics of the various types of television cameras, so I need not go into them in detail, except to say that with the iconoscope we acknowledge its superiority in definition, but also its limitation in the production of undesired shading effects which cannot be controlled. The image iconoscope has the advantage of a little more sensitivity than the iconoscope and less shading troubles. The orthicon with its even field of picture rendering is free from shading, but loses detail; and the image orthicon, with its enormously increased sensitivity, suffers, however, from background noise and great difficulties in manufacture.

(b) *Film Scanners.* There are those, like the Mechau continuous-motion mechanism, installed at the B.B.C., which use the iconoscope, and therefore also suffer from shading distortions of the picture gradation. There is the Farnsworth dissector film scanner which gives an even field, but is difficult to set up to avoid geometrical distortion of the picture. And finally, there is the cathode-ray-tube flying-spot scanner, which can give, under controlled conditions, as good a picture as you would wish to see, with excellent definition and quality, and free from shading.

(c) *Caption or Still-Picture Scanners.* The same remarks apply.

(d) *Means of Distribution.* By radio links, which can carry the full requirement of frequency range, which are flexible in setting up and operation, but which may be subject to interference.

By cable, with limited frequency band and high capital cost.

(e) *Projection.* Cathode-ray-tube projectors, either using a wide-aperture anastigmatic lens or a Schmidt-mirror system, with its great advantage. (Incidentally, I remember testing a Schmidt projection system in 1937⁴.)

Intermediate film projectors, in the operation of which much experience still is to be gained.

Storage projectors of which only one type so far has been shown to be reasonably practicable, namely the AFIF system developed by Professor Fischer of Zurich⁴.

(f) *Screens.* Types of screens with higher reflection coefficients than the normal matt white screen, such as the established types of beaded or silver screens; new types of screens coated with material which is a combination of matt white and silver; and lenticular types of screens varying from the crudely stippled metal screens to the optically designed lenticular screens which project all the received light back into the audience seating only. (Fig. 1.) A screen having a reflecting cone with a vertical angle of 40° and a total horizontal angle of 104° would be ideal for the average theatre.

Arising out of the consideration of the qualities of the various types of equipment referred to (lack of time prevents me from going into a detailed study), we have in my Company evolved an experimental 405-line system which has already been the subject of practical tests, and which for the present consists of:

Telecameras

The image orthicon or image iconoscope.

Telecine

Cathode-ray-tube flying-spot film scanner. (Fig. 2.)

Telecaption

Cathode-ray-tube flying-spot still-picture scanner. (Figs. 3 and 4.)

Teledistribution

Radio links operating with a few watts on a frequency of 480 megacycles at distances up to 12 miles.

Teleprojectors

A Schmidt mirror projector (Figs. 5 and 6) having a 27-inch diameter mirror, and an 18-inch diameter plastic correcting plate; with an aluminium-backed straight-through cathode-ray tube, operating on an anode voltage

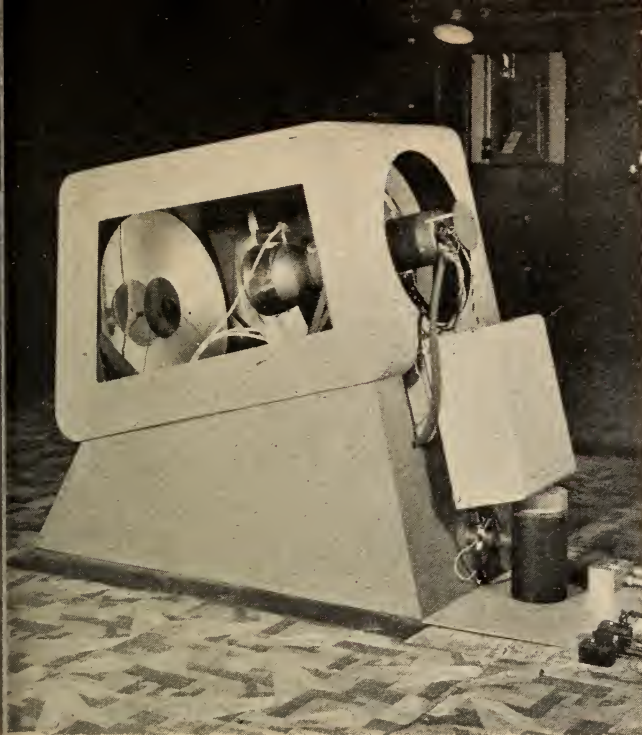


Fig. 5. "Cintel" 27 in. mirror projector for 16- by 12-foot screen. (Front view.)



Fig. 6. "Cintel" mirror projector stalled at the Palais-de-Luxe Cinema, Bromley. (Rear view.)

of 50,000 ; mounted in the stalls, or on the front of the balcony ; remotely controlled from a console installed at the back of the stalls, or in the projection box. (Fig. 7.)

- Theatre Screens

Of a type where the reflected light is concentrated into the area occupied by the audiences.

I must now state the practical results achieved in terms of the fundamental points of performance which I have specified above.

(1) The *definition* over the whole system is such that 3-megacycle vertical bars are resolved in the picture without any noticeable phase defects.

(2) The measured high-light *brightness* on a 14- by 11ft. stippled metal screen in the direction normal to the screen down the centre line of the theatre, is 5 foot-lamberts, compared with the accepted film standard of 7 to 14 foot-lamberts, and the measured black brightness is 0.1 foot-lambert ; and average contrast range during a succession of pictures is 30 : 1. At 30° off the centre line the high-light brightness is 2.5 foot-lamberts. The output of light from the projector with no picture, and running at a brightness corresponding to the maximum usable high-light brightness for a good quality picture, is 300 lumens. A new projector, almost completed, will provide a light output of 600 lumens, adjusted for conditions for good quality picture projection. By the time we get into the London theatres we hope to project 1,000 lumens on to the screen. The colour of the picture is off-white in the direction of cream.* Fig. 8 indicates the progress of definition and brightness over the years, in comparison with the desirable results which are equivalent to the average characteristics of film projection in theatres. The important point about these curves is that the upward tendency continues and there is no sign yet of a slowing up of progress, which might be indicated by a flattening of the curves.

*See Addendum, page 200.

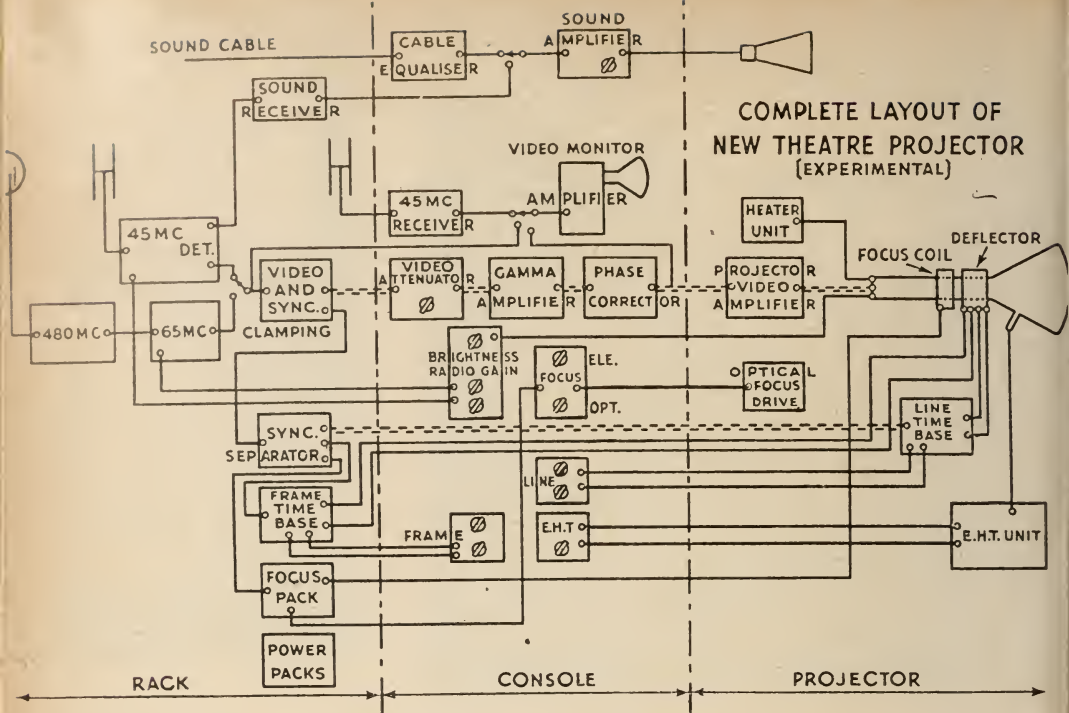


Fig. 7. Block diagram showing three main units of "Cintel" 1947 theatre projector, capable of operating off cable input, and off 45- and 480-megacycle radio inputs.

(3) The estimated *over-all quality curve* is approximately linear over the range from black to two-thirds the high-light brightness specified in (2) above, and flattens out above that figure. For example, we have measurements indicating a brightness curve for the projector as follows :

A gamma of $\frac{1}{2}$ in the shadows, caused mainly by scattered light.

A gamma of 2 over the greater part of the curve up to $\frac{1}{2}$ high-light brightness.

A gamma dropping to $\frac{1}{2}$ at the upper values of brightness due to electron-beam defocusing at high current, saturation in the fluorescent powder, and other causes.

This distortion, if measured correctly, can be mostly made good to provide an over-all constant-gamma condition.

(4) With regard to *freedom from interference*, I must admit that there is much to be desired with existing standards, and with relatively uncontrolled local noises. Under the best conditions these can be a relatively unimportant factor, but on occasions the interference may be troublesome and cause annoyance to the spectator.

Proposals for an Experimental System for the London Area

The complete system described above, and which is in practical operation in an experimental form, and can be engineered in a form suitable for the production of a serviceable instrument, is, in my opinion, a first practical solution which we can offer to the kinema interests. It is a long way ahead of the 1939 equipment. It is up to them to decide how, where, and when they can use it to advantage.

Our recommendation is to set up a sample system in daily operation for invited and paying audiences. Fig. 9 illustrates a plan of a proposed experimental system which we hope to work out during 1948 to give us this experience. Programmes are to be provided from three centres : the B.B.C. Studios at Alexandra Palace in the north of London, the Pinewood Film Production Studios of the Rank Organisation to the west of London, and the Crystal

Palace site on the southern side overlooking London, where we shall set up a central receiving station and retransmitting station, and some local scanners for the transmission of films, interviews, and announcements. The radio links will be on frequencies just above and below 480 megacycles. Retransmissions will be beamed, from the Crystal Palace, with an angle of 10° in the direction of certain theatres which are suitable for the installation of the projection equipment. We have in mind four West End theatres and two suburban theatres. One beam will suffice to cover the London West End kinemas and a selected northwestern suburban kinema, and another beam will cover a suburban kinema in the south-eastern area of London.

Figs. 10 and 11 are elevations of two of the selected kinemas showing our proposals for equipping them.

Audience Reaction

So far, nothing has yet been done, as far as I know, on either side of the Atlantic, which would give the exhibitor some practical figures and experience to gauge future public requirements. We badly need experience on

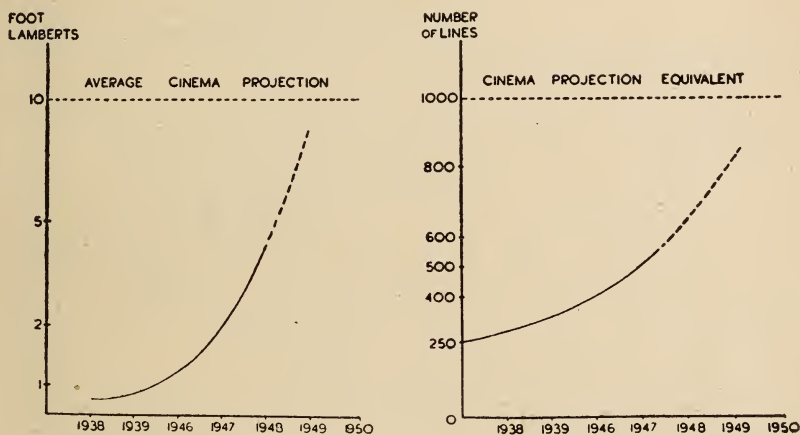


Fig. 8. Progress of brightness and equivalent definition in large-screen (16- by 12-foot) television projection.

public reactions to a regular service beyond the stage when television was just a novelty and used only on special occasions.

We recently invited a cross section of our employees to see a projected B.B.C. programme (lasting $1\frac{1}{4}$ hours) in the kinema which we had equipped with the projection installation described above. These employees had been working some distance away in other factories, and had not seen any large-screen pictures before. The entertainment value of the programme projected happened to be poor. This was beyond our control, but we were agreeably surprised at the tone of the response to the questionnaire which was circulated to each employee afterwards, asking for impressions.

Now to come to an audience of enthusiasts, where there is no question at all regarding the practicability of utilising large-screen television up to its present degree of performance.

We were invited at the beginning of the month to assist at the Conservative Conference which was held at Brighton on the south coast of England, in the large 3,000-seater Dome, built in the oriental style, by King George IV in 1805. As an attendance of 4,000 persons at the Conference was anticipated, room had to be found for an overflow meeting in the Dolphin Theatre,

a 1,000-seater, and about 500 feet away from the Dome. We set up image-orthicon cameras, manufactured for us by the Du Mont Company, facing the platform in the Dome, one for the close-up of the speakers and the other for a general view of Mr. Churchill's Shadow Cabinet on the platform. The picture was reproduced on a 14- by 11ft. screen on the stage of the distant theatre, on a 405-line basis, with a Schmidt projector operating on 40,000 volts, and giving a high-light brightness down the centre of the theatre of 4 foot-lamberts. To enable the delegates to study their agenda papers there was about $\frac{1}{3}$ lighting left on in the theatre. We had accepted this invitation to gain experience, and we certainly did get that experience from the enthusiastic Party representatives, especially on the occasion when their Leader was speaking. Throughout the three days of the Conference, the theatre was filled to overflowing, and many of the visitors preferred the close-up of the speakers on the large screen to the more distant view in the large Dome. On the last day, I sat at various points in the theatre and took Leica snapshots, at exposures of $\frac{1}{10}$ of a second, using an $f/2$ lens and Super-

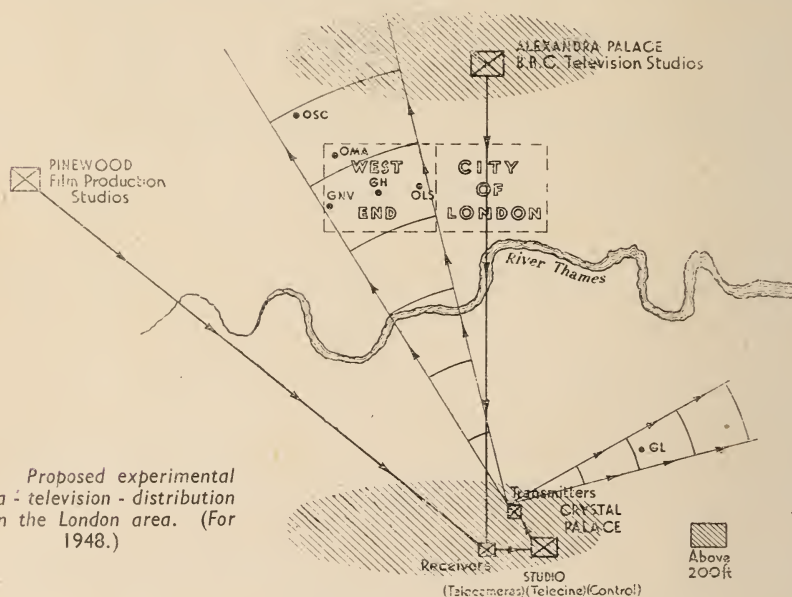


Fig. 9. Proposed experimental kinema-television-distribution plan in the London area. (For 1948.)

XX film, of the large-screen results, and I am happy to be able to present some of the results here, and I am more than happy that they represent one who is, I believe, regarded throughout the world, and even in Britain also, as one of the greatest leaders of our time. (Fig. 12.)

Installation and Regulations

Finally, there is one factor not to be ignored: the installation problem, especially in relation to national or local regulations which, when originally framed, did not envisage the use of television in theatres.

In Great Britain the authorities are busy drafting more and more new regulations. Everything has to be regulated. The old original Cinematograph Act of 1909 (amended only once since that date in 1923 and before the advent of sound, and still legally in force) would close *half* the kinemas in the country if the letter of the law were observed. A new amendment of the old Act is now in preparation, and has been drafted, and would,

according to the exhibitors, close *all* kinemas. Clauses have been drafted in anticipation of the installation of television equipment, and in such a form (I should say without malice aforethought) that would make it quite impossible to install television in kinemas. For example, the draft stipulates that a television projector set up in the theatre must be completely surrounded by 14in. brick walls without any doors. We have visions of the projectionist being built in with the projector and remaining there all the rest of his life. But I must admit that the authorities are, however, open to suggestions for improvements in the regulations.

In actual practice, we have never had any difficulty in satisfying local authorities from the points of view of safety and fire. We have found them most co-operative and as anxious to gain experience in the new type of equipment and its installation as we are.

V. REQUIREMENTS FOR THE IMMEDIATE FUTURE

I have dealt with the present state of the art in Great Britain. I may have painted, perhaps, too rosy a picture, but I prefer to be an optimist,

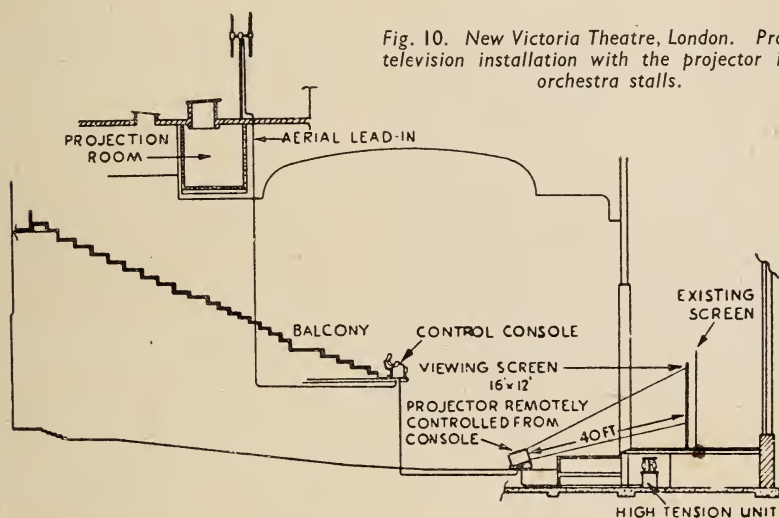


Fig. 10. New Victoria Theatre, London. Proposed television installation with the projector in the orchestra stalls.

recognising that we still have a long way to go. Our present problems are as follows :

I. Technical

We have to improve detail, quality, projection brightness, and freedom from miscellaneous minor but irritating defects. I prefer to group all these points together and to refer to some of the fundamental problems associated with all of them.

(a) *Number of Lines for Theatre Standardisation.* We have seen many references to the 1,000-line desirability. On the other hand, we have often heard that our 405-line system at its best is enough. That, of course, refers to a controlled local picture. Therefore, ignoring for the moment all the excellent work which so far has been done in trying to establish the minimum basis for either home or large-screen projection, we decided to start afresh and make a practical investigation with many observers, of the brightness-resolution-contrast relationship in projected pictures.

Some of the preliminary conclusions are given in Fig. 13, which shows the result of observations made on line patterns of various dimensions exhibiting varying degrees of contrast and illuminated at various values of brightness. The curves in the diagram connecting brightness, resolution, and contrast should be taken as indicative of the order of magnitude involved, where the unit of relative brightness represents the normal high-light brightness of a projected picture, say approximately 10 foot-lamberts. The number N of test lines per picture height is equivalent to the number KN of lines of television scanning, where the factor K lies between 2 and 3. Curve A indicates that the eye can appreciate up to something between a 950- and 1,400-line picture at a brightness of 10 foot-lamberts; but in practice, according to curve D , the result of observations of projected films, it is satisfied with something between a 650- and 950-line picture at that brightness. Arising from this, it appears to be desirable that we should aim at a standard of something round about 900 lines for theatre television, and up to 1,200 lines, if we wish to record a picture on film which will provide prints equivalent to normal film practice.

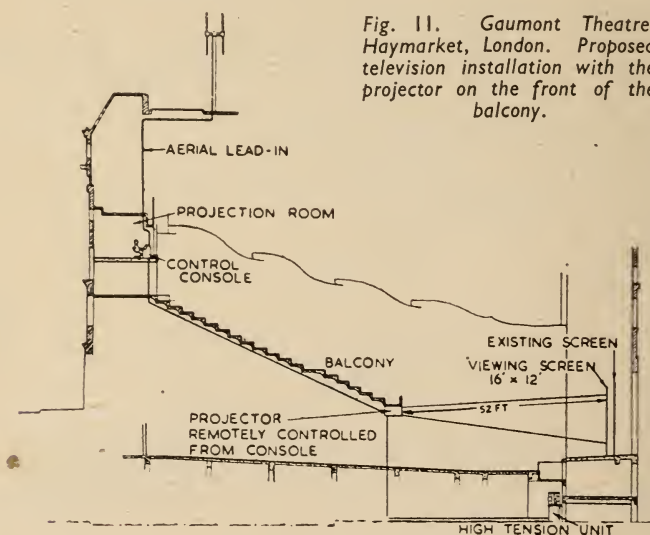


Fig. 11. Gaumont Theatre, Haymarket, London. Proposed television installation with the projector on the front of the balcony.

(b) *Systems of Scanning.* We have got too much into the way of a tacit acceptance of double interlacing, based on a theoretical calculation of its advantages. I am not at all sure that practice has proved this.

At the recent Cannes Conference it was generally agreed that the time was ripe for a renewed investigation of sequential processes. In fact, all the authorities there admitted, as a result of their practical experience of results using interlaced scanning, that they would prefer a 500-line sequential picture at 50 frames per second to a 1,000-line interlaced picture at 50 frames, 25 pictures a second.

The following defects are observed in interlaced scanning: line crawling, interline flicker, spurious pattern flicker, line break-up on movement, pairing or loss of interlace, unequal field brightness, irregularities and irritating effects on vision, and complexity of circuits and equipment.

Some of these also appear with sequential scanning, with the added disadvantage for a given channel bandwidth of greater "lininess" and lower definition.

The list of interlacing defects is formidable, and indicates the reason for

disquiet as to the future of interlacing in improved television systems. The advantages, however, such as terms of improved definition, are not to be lightly disregarded. The final choice, to interlace or not, cannot be decided without further observational data.

A number of various comparisons can be made, but they all resolve themselves into a choice between either a loss of definition or the presence of flicker and stroboscopic defects. Other factors which will require attention in this investigation are the compromise between vertical and horizontal resolution, and the value of artificial means for line broadening to reduce "lininess."

In drawing your attention again to sequential scanning, I should like to mention that recently we made an equipment to demonstrate the principles of scanning a picture and reconstituting it, for the Science Museum in London, in connection with the Election Jubilee Exhibition. We employed a scanning of 100 lines sequential, and the reproduced picture had a remarkable element of stability, in fact the rigidity of a lantern slide, and we were not unduly bothered by the limitations of definition due to the low number of scanning lines. In my opinion, in introducing interlaced scanning we have deliberately tried to deceive the eye, and the eye will not stand to be deceived, and it is in this connection that we shall find advantages when we come to achieve any system of storage projection.

We have made some interesting tests, originally out of curiosity more than anything else, to compare the results of projecting, one after the other, an intermediate film picture and an interlaced electronic picture on the large screen, of the same subject scanned with the same number of lines, and we were remarkably surprised at the amount of irritation, as you might describe it, produced by the interlaced projected television picture on the eye, in comparison with the steady restfulness of the projected intermediate film picture. I have an idea that here we have a vital point regarding vision which needs much more study; and, furthermore, that an electronic sequential picture will occupy an intermediate place between the other two regarding the general stability and freedom from irritation (and from consequent headaches) desirable for large-screen projection.

(c) *Channel Bandwidth.* We have had to change our minds during the last two years regarding the amount of intelligence which can be carried on a 3-megacycle channel. Now we find that we are able to squeeze much more apparent detail and quality into a channel with a definite cutoff at 3 megacycles, and we have been remarkably surprised at the general increase of performance which has been achieved by correcting for response, phase, gamma, and other requirements throughout the whole system within this limitation of frequency. Up to now for the 1,000-line transmission, the bandwidth of up to 20 megacycles has been mentioned. We believe that we shall achieve all we want to do by concentrating on obtaining the maximum value that can be obtained on a channel up to 12 megacycles only.

(d) *Quality of Picture.* We have been in the past, I feel, content to have seen occasionally, when all conditions were right, a picture of good quality,



Fig. 12. Mr. Churchill speaking by large-screen projection (14 by 11 feet).

and then to feel that we had achieved a result which would be universally acceptable. It is only recently that a full study has been made of the component and over-all linearity of the system and that steps have been taken to correct errors in gamma. This process of gamma control, which ensures that the relative brightness of parts of the reproduced picture bear a linear relationship to the corresponding parts of the picture being scanned, is of vital importance in ensuring a picture of first-class quality. It is only when a system has been set up which complies reasonably well with this condition and registers an over-all gamma of about 1 that one realises the enormous improvement in general quality of the picture. As regards projection, I am convinced that so far no projector of any type complies with this condition. As previously mentioned, there is a distortion of the gamma curve, particularly in the high-light region, and this must be corrected first, by studying each element of the system in turn, and, second, by applying

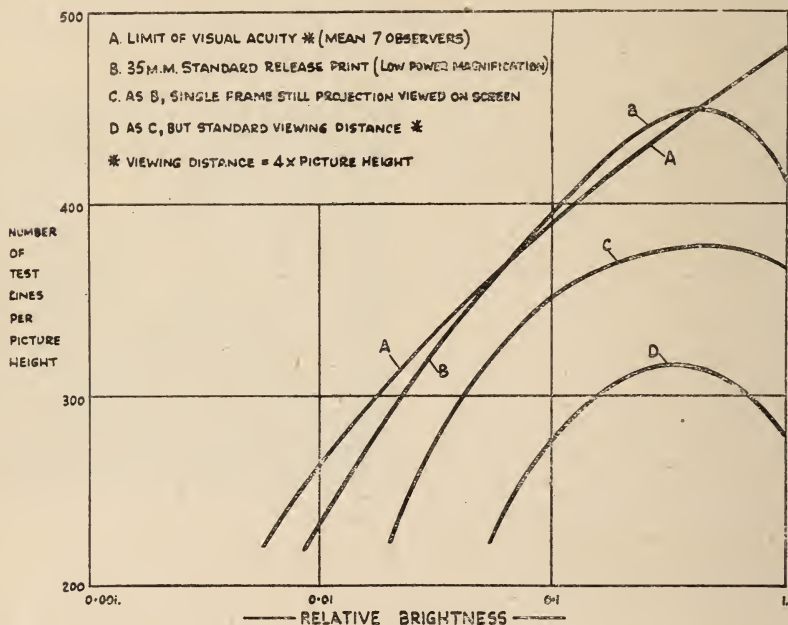


Fig. 13. Investigation of brightness-resolution-contrast characteristics. Data for centre of field, with low-contrast test object. (Density difference 0.3, equal line width-line spacing.) Constant "average" brightness of picture.

an over-all correction when each element has been improved as far as it will go.

(e) *Picture Brightness.* In the cathode-ray-tube projector the curve connecting brightness with anode voltage on the cathode-ray-tube, and the curve connecting brightness with beam current, both show saturation, which begins at a certain high-light brightness on the viewing screen. The problem of extending the brightness curves is one of the most important that we have at the moment. This involves the following studies :

- (i) The development of optical systems of the mirror type to even greater efficiency than the Schmidt.
- (ii) The development of tube electronic characteristics so that defocusing is controlled with an increase of voltage and current.
- (iii) The development of a fluorescent material and its application to the face of the

tube, studying in particular the problems of high-current saturation, defocusing, and halation in the layer ; and also its colour and life characteristics.

- (iv) The development of the viewing screen providing more economical use of the light projected on it, so that it is reflected back where it is required and not dissipated throughout the theatre.

2. Distribution Systems

Considerable study has been made of the relative advantages and disadvantages of cable and radio means of distribution. On behalf of the radio link, we find lower capital and running costs, more flexibility in operation, and against it the scarcity of channels, and interference ; on behalf of cable, a clear and undisturbed channel (at least we hope so), and secrecy ; against cable, the high cost of installation, resulting in high rental charges, and the length of time before the installation can be carried out, due to higher priority for installation labour. In Great Britain, both radio and cable links are controlled by the Postmaster General, and in the set-up of a radio system of a permanent nature, such a system would most likely not be licensed for commercial operation, but would be taken over by the Post Office to operate in whatever manner it thinks fit. However, the exceedingly high charges for the rental of coaxial cables (something in the nature of £600 per mile per annum for a 3-megacycle cable has been quoted) with no definite date of availability promised within the next five to ten years, make it imperative to provide experimentally a radio-link system, and the first steps in this direction already have been described. In the meantime, the first link in the provincial distribution system of B.B.C. television programmes has been started. Work has commenced on a radio link between London and Birmingham to operate on 900 megacycles.

Although you are, for your own commercial kinema schemes, pressing for allocations of frequencies above 1,000 megacycles for radio links, we are pressing for the 500- to 1,000-megacycle band, because this range offers, in our opinion, advantages for wide-band television which may not be possible in the regions above 1,000 megacycles.

3. Programme

Here we have many problems, the majority of which are outside our technical province. I have already referred to some of them. Others causing us much thought in England are as follows :

(a) *Licence to Operate Commercially.* Over two years ago we asked the government to consider giving us facilities to operate on a commercial basis between our studios and theatres. The permission is concerned with the means of transmission and distribution. In other words, we ask for a licence to use the ether or the facilities provided by Post Office cables. In this respect we are dependent on the Television Advisory Committee (which has taken the place of the original Television Committee), and this Advisory Committee has been taking plenty of evidence during the last two years but has been very slow in making the appropriate recommendations to the Postmaster General, who would present them, if he agreed, to Parliament for ratification.

(b) *Three-Cornered Interests.* It may be that although the report of the Television Committee advised that steps should be taken toward the encouragement and establishment of a television service for kinemas, the delay in the granting of a licence to operate commercially has been mainly due to the difficulty of getting together in agreement the three interests who are mostly concerned :

- (i) The B.B.C. and its home viewing audience.
- (ii) The promoters of sporting events, some of which can be classified as being of a national nature.
- (iii) The kinema interests.

Therefore, if these three could be got to work together in harmony, with full co-operation in the provision and exchange of programme material, the authorisation of a licence which would give the kinema interests a start in commercialising television might be forthcoming. However, pressure in this direction is bound to come when technical results are obtained, which justify in themselves that a perfected invention of this nature should be utilised for the nation's benefit. In any case, as the price of home television receiving sets is for the time being higher than the purchase level of the majority of the population, is not television in the kinema the average man's way of participating in this form of entertainment?

(c) *Place of Television in the Theatre Programme.* What do theatre interests intend to do with television? This is a question which, as mentioned before, needs very careful study of all factors by the entertainment industry. I have not yet heard a balanced and well-thought-out reply to this problem.

Are we wrong in assuming that large-screen television and kinematographic projection can be made complementary to each other? Can we show them both in the same programme?

On the long or very long view, the answer is yes. But in the meantime, those who have financed its development must be thinking of some return. In which case, can we commercialise on an intermediate stage either by (i) provision of specialised television theatres; or (ii) provision of television in kinema theatres, but television and film each taking a separate and independent programme period for itself?

(d) *Instantaneous Versus Delayed Action.* I am not at all clear as to the relative uses of instantaneous electronic projection of television in theatres, and the delayed-action presentation by using the intermediate film process. There are so many factors controlling the timing of programmes in theatres that it would be extremely difficult to guarantee that all theatres taking a particular programme would be standing by at exactly the correct moment. On the other hand, I cannot visualise the practical operation and maintenance of intermediate film equipment in individual theatres.

There is one thing of which I am quite certain. I have many times experienced the tenseness of an audience watching, as it is taking place, on the kinema screen, a national event, the outcome of which is unknown, and I am convinced of the enormous entertainment value of such an item. The satisfaction which I personally have experienced on such an occasion has been acknowledged also by all those present. The important point is that the event is being watched as it is happening, and half the entertainment value would be lost with delayed presentation.

I feel, however, that the best way out of this problem is not by writing and talking, but by setting out to obtain practical experience in both methods over a period of time; such work to be done in close co-operation between the technicians and the leaders of the entertainment industry, and it is only by facing this problem fairly and squarely that we can really get a solution that will satisfy future requirements in the provision and extension of the kinema television service.

4. General Economic Problem

Although I am not qualified to discuss this subject, I feel that this is a matter which must not be left unmentioned in a general survey of this nature.

In looking ahead, as the technician must look ahead, toward the future of the entertainment industry and the impact of technical progress on it, we must attempt to visualise the various possibilities which may arise, so that we can provide information for those whose duty it is to study the economic trend in relation to the ever-changing needs and tastes of the public served by the industry. Here we have in large-screen television a new tool rapidly

approaching the practical stage where it can be of value for entertainment and education. It is our duty to give guidance, as far as we can, so that it can be used to the best public advantage. I hope that this paper will, in describing past experiences, and in discussing present problems and future possibilities, make some contribution in this direction.

VI. CONCLUSION

Finally, I should like to put to you a few questions, based on my remarks, and eagerly await your considered replies :

(1) Do you agree that the presentation of large-screen television to the public should be made in two distinct stages ?

Stage (i) on the 400- or 525-line basis, or the 3-megacycle band-width limit,

Stage (ii) the equivalent to film projection. Or should we wait until Stage (ii) is an accomplished fact ?

(2) What do you regard as technical requirements for Stage (ii) ?

(a) Number of lines.

(b) Sequential or interlaced.

(c) Bandwidth.

(3) Should we really make a comparison with film projection ? Should not public television develop as a different medium, and to a different standard ?

(4) What will be the comparative practical uses for :

(a) Film intermediary.

(b) Instantaneous electronic projection.

(5) How will theatre television be used by the entertainment interests ?

Acknowledgments

I must give credit and appreciation to the members of my team, who work with unequalled enthusiasm and unity of purpose in endeavouring to solve our problems : Messrs. T. M. C. Lance, J. D. Percy, T. C. Nuttall, L. C. Jesty, L. R. Johnson, K. A. R. Samson, E. McConnell, M. Morgan, J. E. B. Jacob, and many others ; also to Dr. C. Szegho, now with the Rauland Corporation ; and to Dr. Starkie of Imperial Chemical Industries (Plastics Division) who has carried out the optical work for projection ; and Mr. Warmisham of Taylor Hobson for the optical work on the scanning side.

Following the delivery of his paper, Mr. West showed a short film, divided into two parts : (1) the recording of B.B.C. programmes with particular reference to faults encountered, and (2) the recording of pictures transmitted by "Cintel" film and caption scanners.

DISCUSSION

Mr. FRASER : Was the film that was just shown a 16 mm. film ?

Mr. A. G. D. WEST : Yes, reversal 16 mm. film.

Mr. FRASER : Has anyone attempted to count the number of scanning lines to see if there are 405 or 202½ ?

Mr. WEST : I think it is likely that there is quite a lot of pairing. As I have mentioned, we are concerned about the difficulties of correct interlacing. We have an idea that not more than 10 per cent. of receivers interlace properly. Does that hold on this side of the Atlantic ?

Mr. SIEGFRIED : What is the greatest

projection distance that Mr. West has employed with practical results, and what is the largest picture ?

Mr. WEST : The projection distance maximum is 40 feet from the screen. We have not been farther back than that.

Mr. BEN SCHLANGER : There was one of the theatre diagrams which you showed which had a television projector on the face of the balcony. It did seem to me as though that was one of the best locations. The projector did not seem to obstruct the view from any part of the audience. It seems to be the most practical job. Is that true ?

Mr. WEST : Yes. We fully agree with

that. We should be very pleased to see theatres which had balconies coming out to, say, 50 feet from the screen. That would be the ideal position for the projector, but few existing theatres satisfy that condition. Most of them are 70 or perhaps 90 feet back.

Mr. SCHLANGER: In contemplation of building a new theatre, might that be the course to follow?

Mr. WEST: Yes, sir. Obviously it would be preferable to have the projector back in the box which is the right place for it, but in determining the best position for the projector in the auditorium we are subservient to the economic cost. I believe that we could produce a large projector with a 40-inch mirror which could be put in the projection box, and would provide sufficient brightness, but it would be very expensive. The glasswork alone might cost about \$16,000 and furthermore the production output would be very slow. I believe it is the same over here. It might take two years to produce one only. It, therefore, appears to be neither an economic nor a practical proposition.

We, therefore, have to compromise with a smaller mirror, smaller dimensions of projector, and a smaller throw distance to secure the brightness for a given size screen. If theatres are to be designed for the purpose of large-screen television, then the balcony should be designed so that the projector can be mounted on the front of it at a distance not more than 50 feet from the screen.

Mr. PAUL J. LARSEN: I agree that the front of the balcony is a very nice position for the projector, but there is, in my opinion, a very much better place where the projector can be placed in theatres without disturbing the seating arrangements or

anything else, and that is by hanging it from the ceiling. It can be supported there very rigidly and solidly, and projecting downward to the screen. In that way you could have your control box located in the projection room or in the balcony, and that would not be taking up any space in the orchestra stalls.

Mr. WEST: That is an interesting point of view. I think that we are rather afraid that our roofs are not strong enough to support the equipment. There is the question of servicing the projector also.

Mr. LARSEN: It could hang from the ceiling most of the time just like a chandelier, and it could be lowered to the floor by pulley rope when servicing is required.

Mr. WEST: Would not roof vibration cause trouble?

Mr. LARSEN: I do not believe that it would be serious. I do recall some tests made some time ago in projecting still pictures that way. Naturally you would not depend on a single rope but you may use a triangular rope arrangement which would hold it quite steady.

Mr. SCHLANGER: Would not that be in the line of the film projection in the projection room?

Mr. LARSEN: You would place it at an angle so that it would not be.

Mr. SCHLANGER: That might require quite a steep angle from the television projector to the screen in order to get above the regular beam of the motion picture projector.

Mr. LARSEN: It would not be any worse than trying to have it down in the orchestra and trying to project it up on to the screen.

Mr. SCHLANGER: That position in front of the balcony that I saw in Mr. West's diagram was practically a straight throw,

REFERENCES

The original paper embraced material included in earlier papers, as follows:

1. *J. Brit. Kine. Soc.*, Vol. 2, No. 1, 1939, p. 18.
2. *J. Brit. Kine. Soc.*, Vol. 2, No. 2, 1939, p. 111.
3. *J. Brit. Kine. Soc.*, Vol. 2, No. 2, 1939, p. 113.
4. *Proc. B.K.S. Theatre Div.*, 1945/6, p. 22.
5. *J. Brit. Kine. Soc.*, Vol. 9, No. 1, 1946, p. 13.

ADDENDUM

A paper was delivered by Mr. A. G. D. West at a meeting of the International Television Conference, held at Zurich on September 9th, 1948, which contained similar material to Parts III, IV, and V of the above paper.

Mr. West was however able to report an increased light output of the projector (see Page 189) which enabled a screen measuring 16 ft. \times 12 ft. to be illuminated to a highlight brightness of 8 foot-lamberts, with a contrast ratio of 50 : 1. At 30 degrees off the centre line the highlight brightness was 5 foot-lamberts. The total output of light (calculated both from brightness measurements and from data concerning the luminous efficiency of the equipment) was estimated at 800 to 1,000 lumens. The gamma was almost constant throughout the range. The colour approached closely to a true black-and-white picture.

THE FUNCTION OF EDITING IN FILM MAKING

Hugh Stewart*

Report of a paper read to a joint meeting of the B.K.S. with the A.C.T. on March 24th, 1948.

MR. STEWART said the function of editing in film making was an intangible subject. There were no rules; and each cut was, or should be, a fresh event. Editing really meant a feeling for story value and the ability to manipulate the film to express such a feeling.

At its worst, cutting was a hack job of putting bits of film together in a manner that might or might not spoil the story. At its best, it was a stage of creation. That was an angle on which any cutter would dilate at length. In a properly made studio film there was a definite limit to the creative work of the editor, but the same could be said about direction.

Editing in Perspective

Editors had to get right back and view the problem of film making as a whole in order to get their own craft into its right perspective. The script was, or should be, 80% of the creative part of the film. Direction should be a form of creative interpretation.

Editing was an extension of the same influence. A well-written script, conceived by a writer who knew his job, was a *sine qua non* of successful, and at the same time artistic, film making.

Script Writing

Mr. Stewart expressed the opinion that encouragement should be given to writers to learn the job of presenting a script which could be made into a good film just as they wrote it. Until there were more knowledgeable writers it might be taken for granted that all the good directors and cutters in the world would not enable good pictures to be made.

To many people a script was a succession of pages in a typewritten book. In fact, it could only make sense in terms of images. The inclusion of irrelevant scenes, unnecessary lines and ill-thought-out ideas meant headaches for the director and editor, and did not contribute to the improvement of the film.

Just as the value of a set or an actor could be assessed according to the contribution to the story, so a scene could be envisaged in the same way. Script faults complicated the director's work, and although he might put some of them right, the remainder were passed on intact to the editor. Problems that were not solved as they arose gathered force and landed with impetus in the hands of the editor.

The well written script automatically gave the director a straightforward job, so that his energies could, as was proper, be devoted to directing the actors. This in turn facilitated the work of the editor.

Exemplary Films

One of the best films he had ever cut was, said Mr. Stewart, Alfred Hitchcock's "The Man Who Knew Too Much," in 1934. It joined together with the neatness of a jig-saw puzzle. One scene had been exceptionally interesting to work on from the point of view of creative editing.

In the story the mother, Edna Best, went to a concert at the Albert Hall. As she sat there she realised that an assassin was going to kill an ambassador sitting in the Royal Box. The assassin had also stolen her child, so she was



[Courtesy of the National Film Library]

Fig. 1. A scene in the Albert Hall from "The Man Who Knew Too Much."

there with a double purpose. The words of the chorale being performed included the phrase "Save the Child," which was an ingenious underlining of the second motif which was in her mind, though not in the visible action. Hitchcock made a variety of shots, and the author had the task of piecing them together, using the music as a frame-work.

A similar occasion had arisen during the making of "A Spy in Black," a good film made by Michael Powell in 1938. A German "U" Boat, with Conrad Veidt as Captain, was making its way through a minefield outside the Orkneys. The quality of suspense was very necessary, so a few chart inserts were shot, some underwater submarine shots were found, and a delightful couple of days were spent working up a sequence.

Conveying Atmosphere

Normally a little thought and care soon would reveal what was, within limits, the only way to cut a scene. A film should have an integrity of its own, and continual re-cutting of a scene was the rare exception rather than the rule.

The incompetent director over-covered to secure against not having enough close-ups, or to be able to make a cut if the scene were too long. But the competent director might, by panning and tracking his camera, and moving his artists about, achieve in one shot what would otherwise be done in several set-ups cut together.

In "Les Enfants du Paradis" Marcel Carné had used with great brilliance various techniques in presenting his story. In the scene where Garance returned to the Count's house and met Lacenaire again, there were very few cuts; the movements of the camera and the actors emphasised the dramatic points and caught the mood of reminiscence. In the subsequent scene between Lacenaire and the Count, both men stood quite still, and the antagonism between them was suggested by the sharpness of the cross-cutting.

Documentary Films

In documentary films the relationship between the work of the writer, director and editor was completely different from that of the general film. The writer had a much vaguer idea of the exact appearance of the actual scene. He might know what the ultimate effect would be, but he could not give directions for achieving it in the same way as he could when writing a scene with directions as to voice pitch and gestures, or with sets built to specification.

The writer of an ordinary script could indicate so exactly what he wanted that he did not need to be aware of the finer points of editorial work. But the vaguer images of a documentary writer required a very exact grasp of editorial detail in order that he might more accurately discipline the construction of his scene.



[Courtesy of London Film Productions, Ltd.]

Fig. 2. The Count and Lacenaire meet.
From "*Les Enfants du Paradis*."

Integrated Work

The well-made studio film had readily ascertainable and evenly balanced components. But the documentary film needed much editorial knowledge by the writer to compensate for the more fluid script. Thus the function of writer, director and editor overlapped far more in making documentary films. In fact it was not possible to make fine distinctions in designating their various activities.

The process of overlapping was found at an extreme in campaign films such as "*Tunisian Victory*." Not until the end of the campaign was it possible to plan a coherent account; in other words, the rushes were all delivered before the script could be written. A rough assembly of all available film was the pre-requisite to creative writing. Thus the work of the writer, director and editor became completely identified.

To attain dramatic interest the greatest variety and use of commentary was made. Sometimes it was in unison with the images, sometimes in complete contrast, and sometimes (best of all) non-existent.

Great Innovators

In film making it was a truism that one had to be continually striving for improvement and constantly searching for novelty. It applied to editing as much as any other aspect.

The techniques of the early film makers were revolutionised by the innovations of D. W. Griffiths, and of Eisenstein and Pudovkin. During the thirties film makers like Capra and Ford tended to reserve the use of single close-ups for moments of great dramatic importance, and to play scenes between two people in "tight twos." Many examples of developments of technique could be quoted, but the achievements of those directors to whom reference had been made acted as a starting point for discussion.

An innovator might shock many people, but if he were a sincere artist his work would make an impression and a contribution to film artistry. It would set a milestone. The general public might be suspicious of something quite different, but they were affected by it. They might turn in



[Courtesy of the Imperial War Museum]

Fig. 3. Two scenes from the Tunisian Campaign in November, 1942. (Left) Australians advancing under cover of a smoke screen. (Right) Sherman Tanks moving up to the front.

relief to that to which they were accustomed, but something had happened to show that taste had moved on.

Post-War Demands

The wide demand for good factual films during the war led to a new kind of entertainment film.

The first popular film that had come out of America since the war was William Wyler's "The Best Years of Our Lives." Its style of writing, directing and editing was obviously different from anything that happened before the war. It was very different, in fact, from Wyler's war-time success "Mrs. Minniver."

Old v. New

Constant development was the most fascinating part of editing. The blending of new ideas with the tradition of the old was used so that the kinema might be progressive and yet avoid unharmonious crankiness. People with new ideas might despise the more conservative producers, but traditional experience was necessary to keep the balance. At the same time, conservative producers might despise men with new ideas, but they could not do without them. Traditional film making unpurged by novelty would become stale, and new ideas were necessary to prevent that.

However, all the techniques and variety of styles would not make a good picture out of a bad one, and in properly organised film making the editor should not be called upon to correct the errors of others. Editors had the great advantage that they had before them examples of how, and how not, to interpret a piece of writing into celluloid. They received the best training in the world for estimating what was the minimum amount of shooting required to put over a scene. The intelligent editor developed an instinct for knowing exactly what was wanted and, provided always that he had the inborn gift of directing actors, his work gave him the basic training required by a film director.

DISCUSSION

MR. K. GORDON : Do you think that co-operation between the director and the editor on the floor is a necessity?

THE AUTHOR : I think it helps.

MISS COBORN : Do you think that the eye and ear do or do not co-operate? Do you believe that strong sound and strong visual can be used together, or in general, that one should give way to the other?

THE AUTHOR : So much depends on the context. I was thinking of the effect in juxtaposition of the enormous close-up at the beginning of "Citizen Kane"—two enormous lips saying the word "Rosebud." On one hand, you can have a strong dramatic sequence which is silent—the

suspense is built up with the use of imagery—and you can have dull visuals where the sound can be exciting.

MR. R. H. CRICKS : Mr. Stewart has suggested that the director should graduate from editing. Should not the script writer also graduate from editing?

THE AUTHOR : The script writer should certainly know editing in the broad sense; he should also know the dramatic impact of camera movement, and have a feeling for the art of the camera.

A VISITOR : Should editors necessarily graduate from first assistant cutters?

THE AUTHOR : First assistants may be efficient technicians, but an editor has to be an artist as well.

TECHNICAL ABSTRACTS

Most of the periodicals here abstracted may be seen in the Society's Library

WILLIAM FRIESE-GREENE, PIONEER AND INVENTOR.

A. Pereira, *Phot. J.*, A, Aug., 1948, p. 176.

In course of an admirable account of the pioneer work of William Friese-Greene, it is claimed that he was the first to make use of celluloid film, to project a film to a public audience, to employ an intermittent movement and synchronised obturation of the light, to make use of a film loop, and to make films in colour.

R. H. C.

THE INDEPENDENT FRAME.

Darrel Catling, *Film Industry*, Feb., 1948; David Rawnsley, *Cine-Technician*, Mar./Apr., 1948.

INDEPENDENT FRAME: THE AUTHENTIC STORY AND ITS FULL MEANING.

Cinema, Jan. 14th, 1948.

"Independent Frame" is a combination of known technical devices which in themselves require: (i) Very careful pre-planning; (ii) Specialised equipment; (iii) Directors, artistes and other creative persons who are able to subordinate their ideas to the requirements of the technical side.

"Independent Frame" is not in itself a system; it is a scientific approach to the business of making films, demanding an alliance of the best technical brains with a statistical outlook.

It is apparent that considerable progress has been made, not only in back projection (upon which the system largely relies), but in securing the "frame of mind" which this particular system requires.

B. H.

ARC WITH MULTIPLE NEGATIVE CARBONS.

L. B. Silva and L. Ligabue, *Nuovo Cimento*, Oct., 1941, p. 361 (abstracted in *Science et Ind. Phot.*, July, 1948, p. 259).

An arc lamp employing six negative carbons, arranged in a plane perpendicular to the positive, is found to be very stable, and to permit of high current density through the positive carbon. The carbons employed are 5mm. to 7mm. positive with 5mm. negatives. The crater brightness is twice that of an arc with a single negative, its colour temperature being approximately 5,000°K.

R. H. C.

CONTINUOUSLY VARIABLE BAND-ELIMINATION FILTER.

Kurt Singer, *J. Soc. Mot. Pic. Eng.*, Vol. 51, No. 2, p. 203.

The use of an amplifier with considerable negative feed-back in conjunction with a Wien bridge circuit gives a very sharply tuned trough in the frequency response. Rejection frequency is adjustable over the audio range in five overlapping bands and a minimum rejection of 50 dB is secured.

N. L.

CIRCUIT FOR CONDENSER MICROPHONES WITH LOW NOISE LEVEL.

J. J. Zaalberg van Zelst, *Philips Technical Review*, Vol. 9, No. 12, p. 357.

The modulation of a D.C. polarising voltage, and the modulation of a H.F. carrier wave respectively are considered as methods of operating a condenser microphone, with particular reference to signal-to-noise ratio.

A third method is described in which the microphone is included in one area of a bridge circuit energised by a high frequency oscillator. Features include low noise level, freedom from induction interference, and absence of a valve "pre-stage" near the microphone.

N. L.

MAGNETIC CUEING FOR PRINTER LIGHT CONTROL

J. Larson, *Amer. Cine.*, July, 1948, p. 231.

Instead of the usual notches on the negative to effect printer light changes, a dot of magnetic paint is applied, energising a magnetic detector which, through an amplifier, a multi-vibrator, and a pilot relay operates the relay controlling the printer light. Both edges of the film may be used, the second to operate fade-in and fade-out devices.

R. H. C.

B.K.S. HONOURS LEADING TECHNICIANS

The conferment of the Hon. Fellowship and Fellowship upon those listed below, as recommended by the Fellowship Committee, was ratified by the Council at its meeting on November 3rd.

HONORARY FELLOWS

WILLIAM G. BARKER

Pioneer film producer, specialising in news-reels. Founder of Ealing Studios in 1902.

CECIL M. HEPWORTH, Hon. F.R.P.S.

Pioneer cinematograph engineer and film producer. Founder of Walton-on-Thames Studios in 1898.

IAN DENIS WRATTEN, F.R.P.S.

Past President, B.K.S. In this country and abroad, has been responsible for the advancement of many aspects of motion picture photography and processing.

FELLOWS

FRANK GEORGE GUNN, M.B.E., F.R.P.S.

For his unselfish devotion to the technical advancement of cinematography, and in particular colour cinematography, for his administrative ability in supervising and training cameramen for colour cinematography both in Peace and War, and for the prominent part he played in making Admiralty technical colour films and gunnery training apparatus, for which he was awarded the M.B.E.

MALCOLM VINCENT HOARE, B.Sc., F.I.B.P.

Has for a period of nine years been primarily responsible for the high standard of tuition enjoyed by cinematography students at the Polytechnic, Regent Street, both in the two-year full-time course and in the evening courses. He has done important work in co-relating scientific education with practical instruction and in encouraging a scientific approach to practical problems, in particular to the control of quality of laboratory output.

THOMAS WILLIAM HOWARD, F.R.P.S.

Is recognised by the Film Production Industry as the leading exponent of Special Effects as applied to the art of Kinematography. He has reached a position of eminence by virtue of his researches and the application of such researches to the betterment of Effects Photography in British Films.

In 1947 his efforts were recognised by the American Academy of Motion Picture Arts and Sciences, when he was awarded the "Statuette" for the best special effects of the year in the film "Blithe Spirit."

FREDERIC NORMAN GEORGE LEEVERS, B.Sc., A.C.G.I.

For his contributions to the technique of sound recording, especially on 16mm. film. (Was elected under the clause permitting those members who were nominated for the Fellowship at the inauguration, but were not elected thereto, to be elected without further nomination.)

FREDERICK A. YOUNG, F.R.P.S.

For his services in the Industry, and, in particular, to the advancement of British Kinematography for which he has always strongly and untiringly worked, for the outstanding quality of the photography for which he has been and is responsible, and for his kindly encouragement to cameramen who have worked under and who freely acknowledge their indebtedness to the master of lighting.

HONORARY MEMBERS

Three of the seven holders of U.N.E.S.C.O. Film Fellowships have arrived in Great Britain and have been made Hon. Members of the B.K.S. They are J. L. Cleinge of Belgium, who is attending Gainsborough Studios, Shepherd's Bush, and D. A. Wronnecki of France and E. van Moerkerken of the Netherlands, who are attending London Film Studios at Shepperton.

THE COUNCIL

Meeting of November 3rd, 1948

Present : Messrs. W. M. Harcourt (*President*), A. W. Watkins (*Vice-President*), L. Knopp (*Deputy Vice-President*), E. Oram (*Hon. Secretary*), P. H. Bastie (*Hon. Treasurer*), F. G. Gunn, R. B. Hartley, B. Honri, A. G. D. West, R. E. Pulman, H. S. Hind and R. H. Cricks (*Technical Consultant*).

B.S.I.—Mr. Oram was appointed to the British Standards Committee on 35mm. Sound and Picture Projectors.

Fellowship Committee.—Recommendations of the Fellowship Committee were received and ratified.

Journal Committee.—A meeting of the Journal Committee was reported and the finances of BRITISH KINEMATOGRAPHY were considered.

Foreign Relations Committee.—Mr. Rex Hartley reported that consideration was being given to a joint letter from the Association Française des Ingénieurs et Techniciens du Cinéma, and the Associazione Tecnica Italiana per la Cinematografia.

Film Mutilation Committee.—Mr. Knopp reported that it was hoped to publish the first three brochures at an early date.

Refreshments at Meetings.—It was agreed that notices indicating that payment was necessary for refreshments at meetings be prepared.

EXECUTIVE COMMITTEE

Meeting of November 3rd, 1948

Present : Messrs. W. M. Harcourt (*President*), A. W. Watkins (*Vice-President*), L. Knopp (*Deputy Vice-President*), I. D. Wratten (*Past President*), E. Oram (*Hon. Secretary*), P. H. Bastie (*Hon. Treasurer*), W. L. Bevir (*Secretary*), and Miss S. M. Barlow (*Assistant Secretary*).

Honorary Members.—A letter from the British Council was read accepting the offer of Honorary Membership for the seven holders of U.N.E.S.C.O. Film Fellowships offered by the B.F.P.A., during their stay in Great Britain.

Elections.—The following were elected :—

HUBERT JOHN C. BELL (Associate), Plaza Cinema, Plymouth.

NORMAN RUPERT PHELP (Associate), Cinema-Television, Ltd.

NEIL BINNEY (Student), Exclusive Films, Ltd.

JAMES WILLIAM MERCER (Member), Air Ministry.

CATHERINE E. MILLER (Member), Merton Park Studios.

STANLEY ROBERT FINBOW (Member), Air Ministry.

ALFRED WILLIAM WARD (Member), Air Ministry.

ALFRED GEOFFREY SCOTT (Member), New Zealand National Film Unit.

JAMES BRIAN CHANTER (Student), Regent Street Polytechnic.

RALPH CHISHOLM (Student), Rex Cinema, Murton.

ARTHUR MAURICE EVANS (Student), Queen's Hall, Newcastle.

ARCHIBALD JOSEPH HENDERSON (Student), Bensham Picture House, Gateshead.

PETER HERRON (Student), News Theatre, Newcastle.

BRIAN JEFFERSON (Student), Ritz Cinema, Newcastle.

GRAHAM WHITE KELLY (Member), M.-G.-M. British Studios, Ltd.

Transfers.—From Associateship to Membership :—

CORRY WILLIAM FENNELL.

FRANK TREVOR JONES.

JOHN BLYTH.

ARTHUR CHALLINOR.

Re-instatement.—ANTHONY SQUIRE (Member).

BOOK REVIEWS

FILM SCRIPT, by Adrian Brunel, *Burke Publishing Company, Ltd*, 10s. 6d.

A famous novelist, having undertaken to write a script, invited Adrian Brunel to lunch with him with the apparent object of asking him to explain the art and mystery of scenario writing over the cigars and liqueurs. This is one of the many amusing anecdotes in this book and is one that gives your reviewer his cue. For had this book been published at the time, the answer would have been obvious; indeed, the famous novelist could have restricted his expenditure to half a guinea for which he would have secured a thorough exposition of the subject enabling him to embark on his script with full confidence.

A full explanation is here. It covers choice of subject, shape of story, treatment, dialogue and shooting script with a discreet accent on originality and the importance of freedom. Valuable hints are

given on such matters as commentaries and the arrangement of sequences, camera angles, movement and distances, choice of title and the physical make-up of the typed script for presentation.

An eighteen-page dictionary of the principal terms used in film production is included, illustrated in many cases by photographs.

Extracts from actual film scripts form four appendices, three from sound films and one from a silent film.

Let us hope that this book will reach many creative minds which are suffering from "script-fright," and that it will release them from their inhibitions to the enrichment of British cinematography.

K. BARON HARTLEY.

PROJECTIONISTS' FAULT FINDING CHART. *The Fountain Press*, 2s. 6d.

This chart is more than its name implies,

as it also includes tips on how to set up and operate a 16mm. equipment. Something on these lines has been needed for a long time and this handy little booklet should be very useful, especially to the beginner.

Naturally, everyone has his own ideas, but I cannot help feeling that the projectionist would always be well advised to check at the earliest possible stage that his equipment is working; the author places this item rather late in the order of things.

With regard to the chart itself, it is a pity that such things as "machine noise" in the speaker were not included in the list of faults. Nevertheless the chart will give the beginner something to work on, although the experienced projectionist will no doubt think that he can find the fault better in his own way.

H. S. HIND.

JOSEPH CHRISTIAN CABIROL

Died Friday, November 26th, 1948.

Members will have heard with regret of the death of Mr. J. C. Cabirol, Chairman and Managing Director of Pathéscope, Ltd. A French Doctor of Law, he was one of the original Fellows of the Society. Not only was he a member of Council from 1944 until the present year, but his valuable knowledge of Europe showed itself during the period he was Chairman of the Foreign Relations Committee, where he showed special interest. All who knew him valued his sound advice, and his loss will be much felt by the Society.

R. B. H.

PERSONAL ANNOUNCEMENTS

FRIESE-GREENE'S illustrated biography is obtainable in Wardour Street from Films and Equipments, Ltd.

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10s.

Journal of the B.K.S., 1937-46, 4 issues per annum. Price **5s.** per copy.

Divisional Proceedings: Theatre Division, 1944-5, 1945-6. Sub-standard Film Division, 1944-5. **2s. 6d.** per copy.

(*Proceedings of the Film Production Division*, 1945-6, out of print.)

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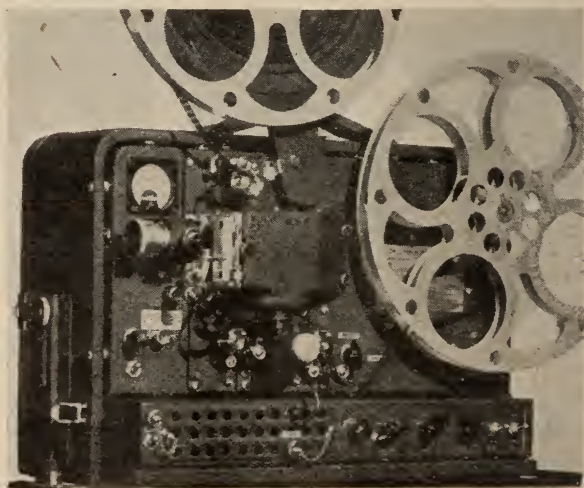
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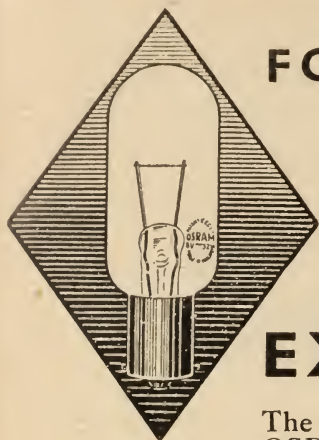
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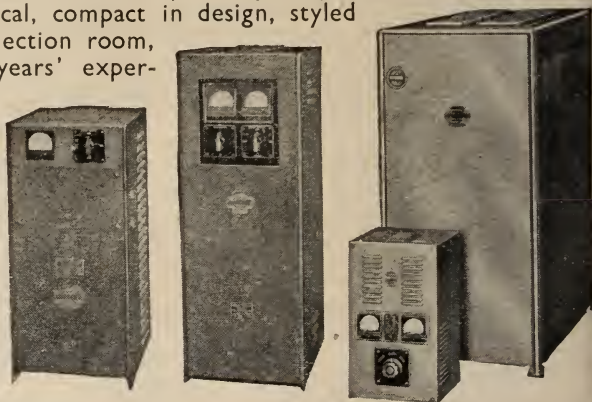
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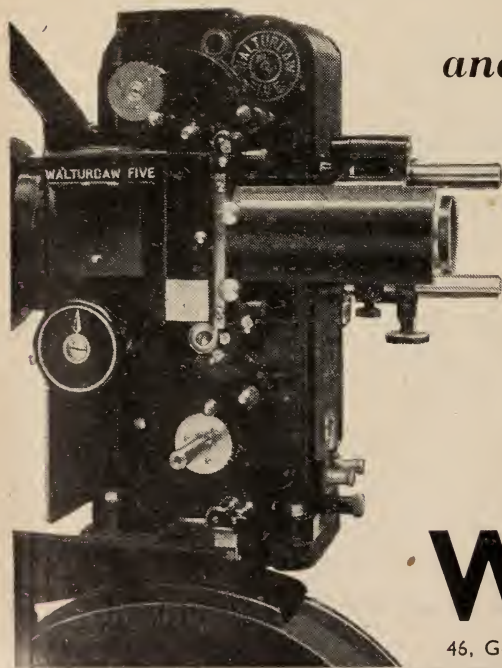
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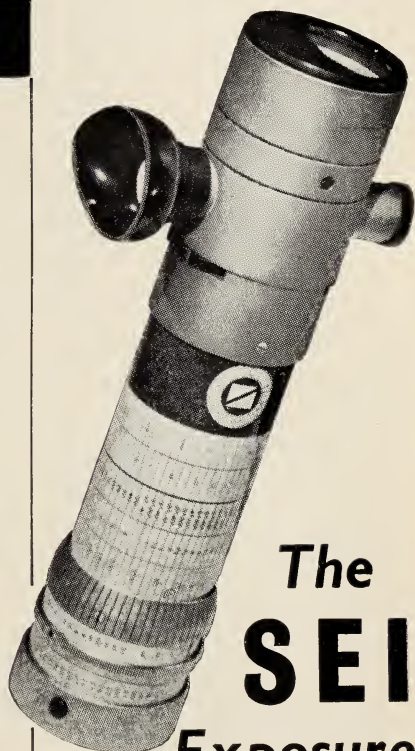
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